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Electrical World

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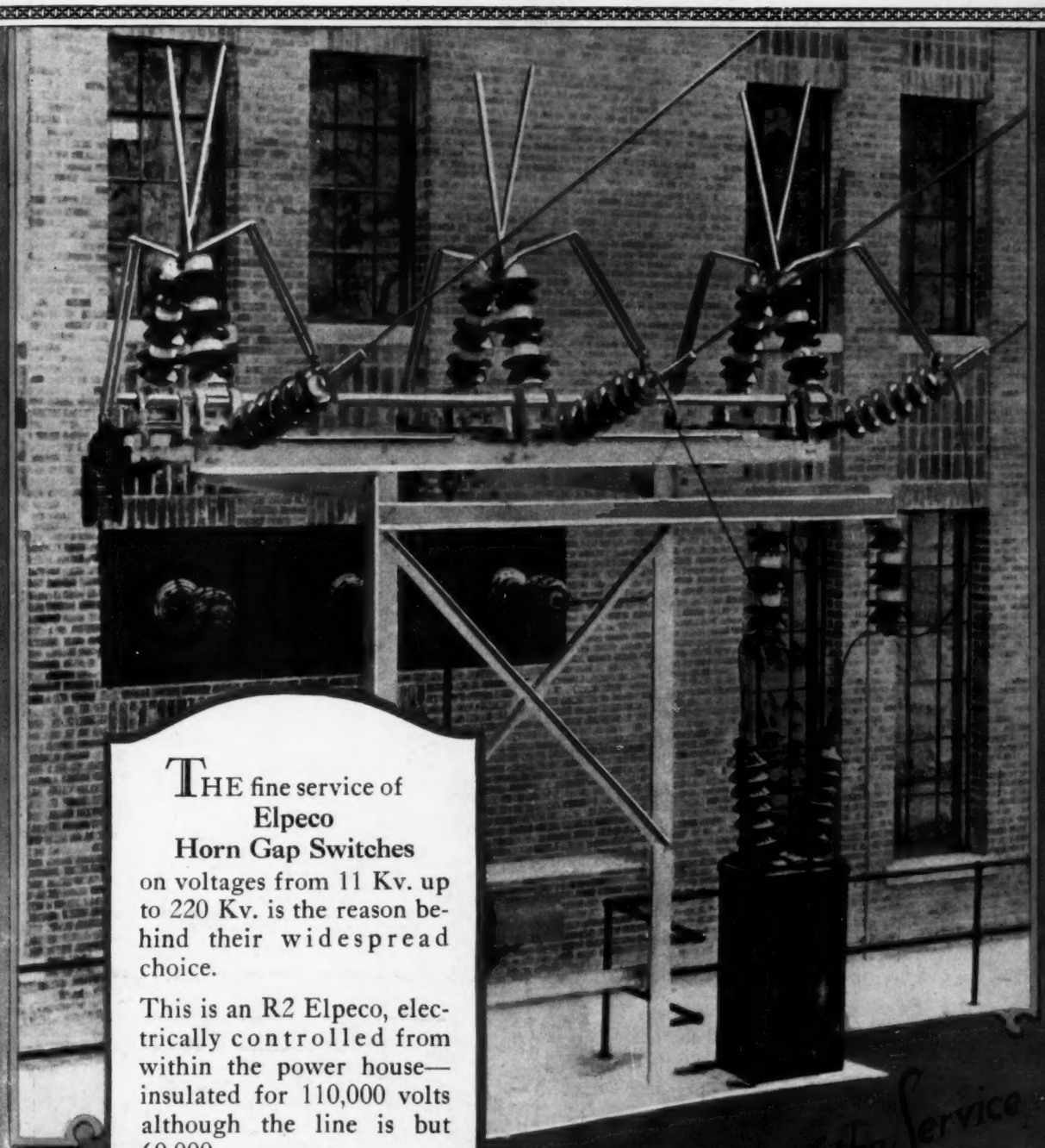

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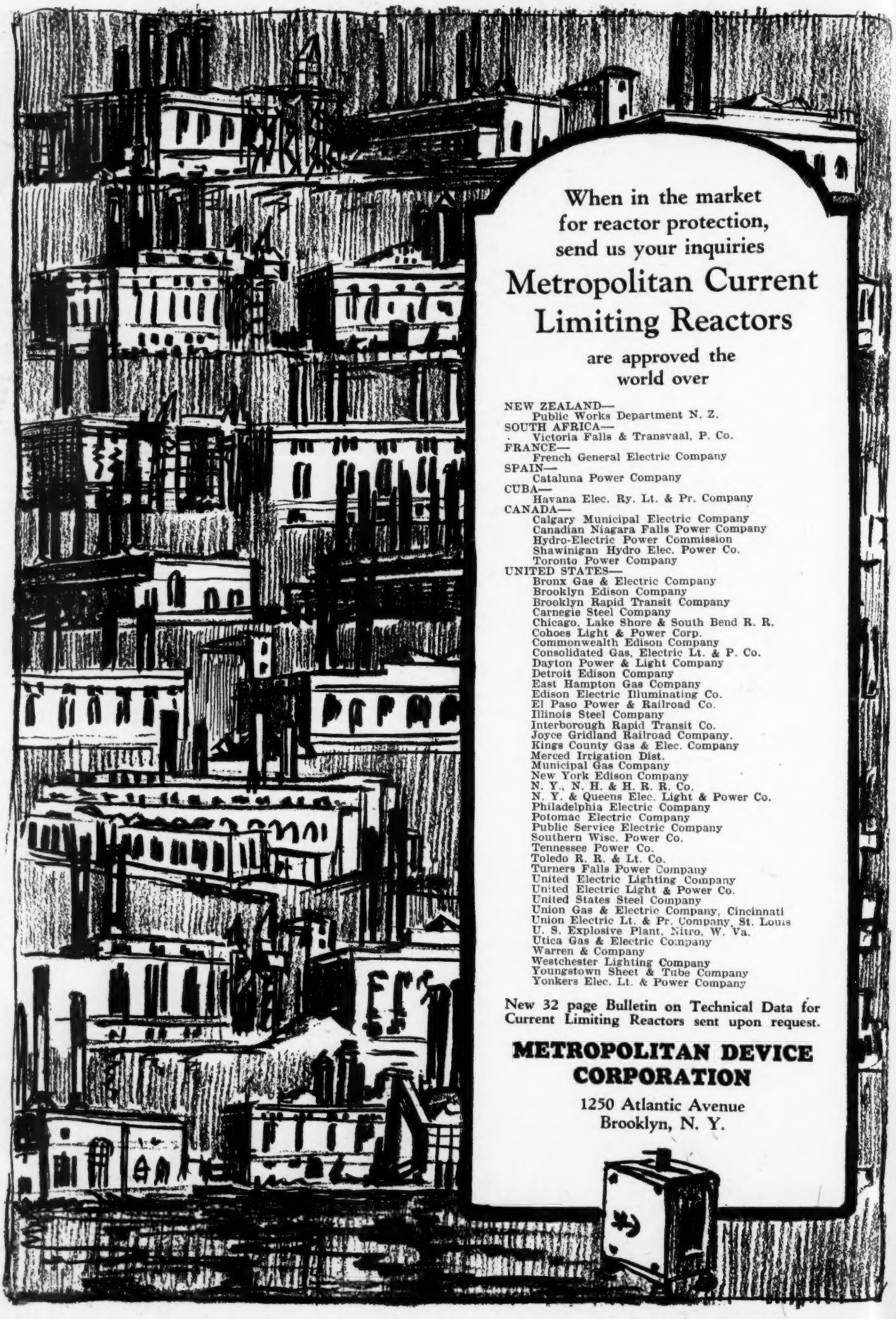

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The Passing of Dr. Alexander C. Humphreys

THOUGH associated almost all his life with the gas industry, Dr. Alexander C. Humphreys was well known outside gas circles, particularly in the larger field of general engineering and education. His death, therefore, means a loss to engineering and to education, in which fields Dr. Humphreys was highly regarded. His contributions to the gas industry were many and profitable. Indeed, it was chiefly because of his association with that industry that Dr. Humphreys was able to indulge his passion for general engineering and education, for the gas industry made him independently wealthy.

The success which came to him professionally followed him throughout his twenty-five years as an educator. Succeeding Dr. Morton as head of Stevens Institute of Technology, Dr. Humphreys guided the destinies of that institution during the years that engineering as a profession began to win respect and a tremendous following. Naturally Stevens grew with the times. Andrew Carnegie was then in the height of his power, and Dr. Humphreys attracted his attention, which meant much for both Stevens and Dr. Humphreys, and also for engineering and engineering education. As a trustee of the Carnegie Foundation for the Advancement of Teaching, Dr. Humphreys' work will long be remembered in scholastic circles. Engineers also will not soon forget his labors in connection with the Engineering Foundation, United Engineering Society and the Engineers' Club in New York. During his lifetime Dr. Humphreys was the recipient of many honors at the hands of his fellow-engineers, and it is but natural that they should lament his loss as that of a great friend and benefactor.

The Higher Efficiency—the Spirit of Partnership

SOMETHING more than the efficiency of the engineer and the economy of the banker is needed in the daily life of the electrical industry. It is not enough to wring the last B.t.u. from each pound of coal and hurl the greatest number of amperes at high potentials from one tall tower to another with least loss. It is hardly sufficient to convince the financier that by spending a million dollars for a new plant or process or for rebuilt facilities the operating company can earn greater returns and produce two hundred thousand dollars where last year it was able to show half of that. What is needed, and needed desperately, is economy in little things—not the mean, nagging economy of suppressive supervision, but the economy of co-operative good will. The line truck driver who lets the engine of his company vehicle idle all through a cold winter's day because it is hard to start would never do that with his own car, and he will depreciate the value of the truck tremendously in the course of the season. The utility that continues to purchase equipment which is consistently poor in its manufacture and assembly although superlative in design pays in time and maintenance costs for that oversight.

What would one hour of more intensive co-operation on the part of every employee of a utility company produce each day? Employee ownership of utility securities is a splendid thing, but, above all things, there is needed an amplification of the spirit of partnership. There are more dollars lost by thoughtlessness than are saved in the heat balance. There are more dollars lost in premature depreciation or obsolescence than are saved with the slide rules.

Utility Recognition by Investors

MONEY for the further development of light and power systems is needed in large amounts. Utility companies are competing with other industries for investment funds which are limited in amount, and it would be desirable to open up new sources of money and to obtain it at a lower cost. To do this it is necessary to gain for utility securities as investments greater recognition and, through an educational campaign, to remove legal and other handicaps. Utility credit is good, but it should be better, and recognition of the field utility issues offer for investment should be very greatly increased.

Aside from government securities, conservative investors still utilize railroad bonds as the chief means for investing money. Through custom, years of experience and tradition, the railroad bonds have reached first place as industrial investments and are accepted and approved by bond houses, banks, insurance companies, savings banks and other financial agencies. It is not generally recognized that the bond of a light and power company is as good security as a railroad bond, if, indeed, it is not better.

An electric utility bond has several investment advantages over other industrial bonds. The light and power business is not subject to seasonal or business variations of magnitude. The load is diversified and in the aggregate is stable, and it steadily increases no matter how industry changes. Another advantage is that no capital is tied up in surplus equipment. Idle capacity in power stations, lines and other service facilities is measured only in terms of insurance reserve, and the business needs to expand its facilities only as these facilities become used. There is no record of fluctuations which make surplus equipment necessary, as is the case with railroads, for example. Another characteristic of the utility business is the long-hour use of facilities. An element in utility finance is that a balanced capital structure is customary whereby bonds, preferred stock and common stock are all used.

This makes for a conservative proportion of bonds in the total capitalization and makes possible a very large number of security holders. Finally, since the light and power industry is regulated by the government, investment values are safeguarded and earnings are stabilized in large measure.

With all these inherent elements of value in a utility bond, there is every reason to establish a credit position for these securities on a par with that of any bond. There is every reason to remove legal restrictions which prevent savings banks and insurance companies and other investment agencies from buying utility bonds. The utility industry needs to widen its money market and needs to reduce the cost of money. It has the evidence on which to attain these objectives and will, it may confidently be predicted, take positive steps to improve the credit and investment situation.

Available Load, 36,000,000 Hp.

APPROXIMATELY 170,000 manufacturing plants in this country had an installed primary power of 36,000,000 hp. at the beginning of 1926. These plants generated 16,000,000,000 kw.-hr. themselves and bought 30,000,000,000 kw.-hr. from utility companies. The figures indicate that the power-selling job in this country has not been done. Some more data of value from the United States Census of Manufactures, published in the ELECTRICAL WORLD of August 13, indicate trends which may be studied by utilities. In two years the primary power installed in manufacturing plants increased 8.2 per cent, or nearly 3,000,000 hp. The installation of electric motors operated by purchased power during the same two years increased 19 per cent, or about 2,500,000 hp. The increase in total rating of electric motors in the two years was nearly 4,000,000 hp. Of this 4,000,000 hp., about 1,500,000 hp. was operated by energy generated in private plants and 2,500,000 hp. by purchased energy.

These data show that private manufacturing plants are still building power plants at a good rate, even if they are purchasing power from utilities at a still more rapid rate. They show that the power business is far from being saturated and that power used in manufacture increases at a rate which offsets any saturation in the number of prospective customers. They show that each utility company can well afford to survey its power business with the idea of doing more selling. Electrical manufacturers should be interested in the fact that there is an 11,000,000-hp. motor market in replacing engine drives in industry. There is plenty of opportunity for all electrical men to sell the electrical idea to industry.

Related Practices in Bus Structures

WHETHER or not one agrees that there is but one best way of doing anything, there is, it would appear, a relationship between a practice that is good and acceptable in one place and another which is in good favor in another locality. Many of our electrical methods of operation, maintenance and design have a fine flavor of universality. Others have not. Truck-type panels, with oil circuit breakers, meters and the like attached to a movable unit, came to us from overseas. High-voltage cables have been developed here largely upon the basis of experience with imported leaded conductors. Our methods and practices have returned to aid utility engineers and operators in other lands.

There is a wide diversity of thought in regard to station bus structures. In America station buses consist largely of flat copper supported on dielectric bases and carried in cell work. Isolation of phases, sectionalizing of bus sections, elaborate protection and interlocking devices are provided to prevent electrical connection under unusual conditions, between phases. Abroad, in direct opposition, the approved method dictates that bus structures be carried in grounded metal containers and separated from them by an insulating solid. In these installations the only possible short circuit or breakdown must be to ground. The next few years should find many installations of the earthed metal conductors in this country.

The Industry Publicly Faces Its Duty to the Contractor

THE electrical industry is at last beginning to face its responsibility for the electrical contractor. No better evidence of this could be asked than was given last week before the convention of the Association of Electragists in St. Louis. For the president of the National Electric Light Association, the vice-president who presides over the Supply Division of the National Electrical Manufacturers' Association and the national chairman of the Electrical Supply Jobbers' Association presented messages that showed a studied effort to effect a closer understanding and a more helpful relationship with the contractor-dealer. President Sands was not present personally, but his paper was read by the president of the local power company.

All this was quite unprecedented. In the past the other groups have been in the habit of shrugging their shoulders at the troubles of the contractors, feeling that these were matters which the contractor should settle for himself. But this attitude is changing because it is beginning to percolate into electrical men's minds that this industry is, after all, a great industrial army engaged in a continuous trade battle with other industries, all competing for the largest possible share of the American household budget. It so happens that the contractors and dealers man our front-line trenches and do our skirmishing. We know that they are unorganized and undernourished—just a mob strung out along the battle front, unequal to the task assigned them and so demoralized that they are often fighting among themselves. Our cavalry, artillery and air service may be good. Our staff may know their maps and tactics. But the fact remains that we are losing this war against competitive industries—selling the home but 7 per cent of what we should—because all the officers and all the troops of the other more popular corps have been "high-hatting" the private soldier in the muddy trenches and leaving him to shift for himself.

These are strong statements, but they are based on facts that cannot be disproved or longer ignored. And so it was that Mr. Sands for the N.E.L.A., in a frank statement, squarely met the issues raised by Joseph A. Fowler at Atlantic City. And so it was that D. H. Murphy for the N.E.M.A. called upon the manufacturers to help build up membership for the Electragists and pledged the aid of his own company. And so it was that G. E. Cullinan urged the jobbers of the county also to set their salesmen to this task and personally pledged the support of the great Graybar organization. Such things have not been seen before.

For several years the meeting of the electragists has

been perhaps the most interesting of all the electrical conventions, from the standpoint of the observer, because of the nature of the problems confronted and the degree of earnest purpose reflected in the program. Yet always there has been a note of tragedy beneath it all. For here are but 2,300 electragists struggling to build up the ethical and economic status of 30,000 contractors, scattered over the land, with 27,700 of whom they have no organized contact. It just cannot be done in time to save the situation unless the other branches of the industry will help. Not to save the contractor, mind you—but to save the electrical industry from the disastrous consequences of a dwindling market, avoidable only when adequate wiring is sold into the 16,000,000 connected homes of America.

Lay the Shade of David Harum

HORSE-TRADING business principles persist in the electrical industry between buyers and sellers. They are based on the premise of getting something for nothing and are applied in a great game of bluff. Buyers play seller against seller to get a low price and have no basic guides whereby they know what they get for their money. The sellers attempt to charge what the traffic will bear, "fall for" obvious purchasing bluffs and ignore their production costs and quality-of-product sales aids.

Yet any one of the human beings who engage in these horse trades in business deals involving thousands of dollars would be insulted if it were suggested that he bought his last suit of clothes after dickering an hour over the price charged. They are the first to admit that a good horse trader gains success through the exploitation of a singular personality which is salted with bluff, skill at barter and the ability to do the unexpected. They are the first to admit that horse-trading business practices result only in losses, instability and a chaotic marketing situation. All agree that price buying and dickering over quotations are bad business, but neither buyer nor seller has the courage to change his practices. Each waits for the other to move first.

Manufacturers start negotiations by quoting a high preliminary price in the happy anticipation that this price may be approved, but with more sincere expectations that it will be lowered before the order is placed. If it is necessary to lower the price below cost, then they are pleased to take the business, because they dream about that next order which is expected to even up the balance sheet and perhaps give a profit. The buyer rubs his hands over each shrewd deal wherein he has played seller against seller in a horse-trading negotiation to get the lowest price possible.

David Harum has been dead many years, but his ghost still walks.

Scientific Revolution and Evolution

IN THE classic theory of thermodynamics the entropy of the world tends to a maximum. We are doomed to a "heat death" in the distant future with the vanishing of all temperature and pressure differences, and the world will become an ice-cold mass. Looking into the past, the world was once at an immeasurable temperature. This gives us an evident contradiction, since the latest theory of relativity says time must be infinite in both directions. The modern theory avoids this pitfall by replacing the unidirectional conception of energy change by a theory involving fluctuations between more or less probable states—thus allowing us to hope for a more or less sinuous evolution for all eternity. But permissible conclusions thought out to the end make one very skeptical of even this modified theory of Boltzmann, especially when the "quantum" idea of Planck is introduced.

Nothing seems to stay "put" under rigorous research. The electronic theory has brushed aside unceremoniously the famous equations of Maxwell. Einstein shook the foundations of classic conceptions of the laws of nature. The second law of thermodynamics has been disproved unless modified so as to permit the possibility of perpetual motion. More and more the valid law to apply to phenomena in nature lies in the statutes of causality. Modern molecular statistics govern the universe. We have just arrived at the conclusion that the world was made by the casual and blind collisions of atoms none of which knew anything about the other.

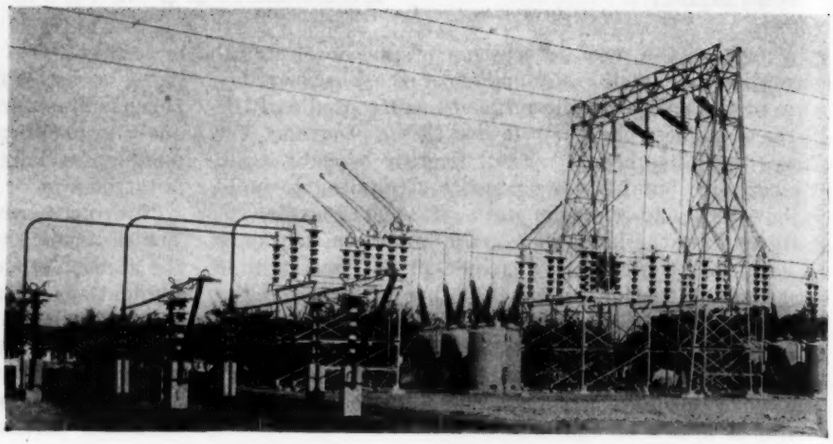
We are now free. We have yielded and given up premature conclusions and perishable laws of nature. But the scientific work of the past places data in our hands even though it cannot yet be correlated. The golden opportunity for research is here.

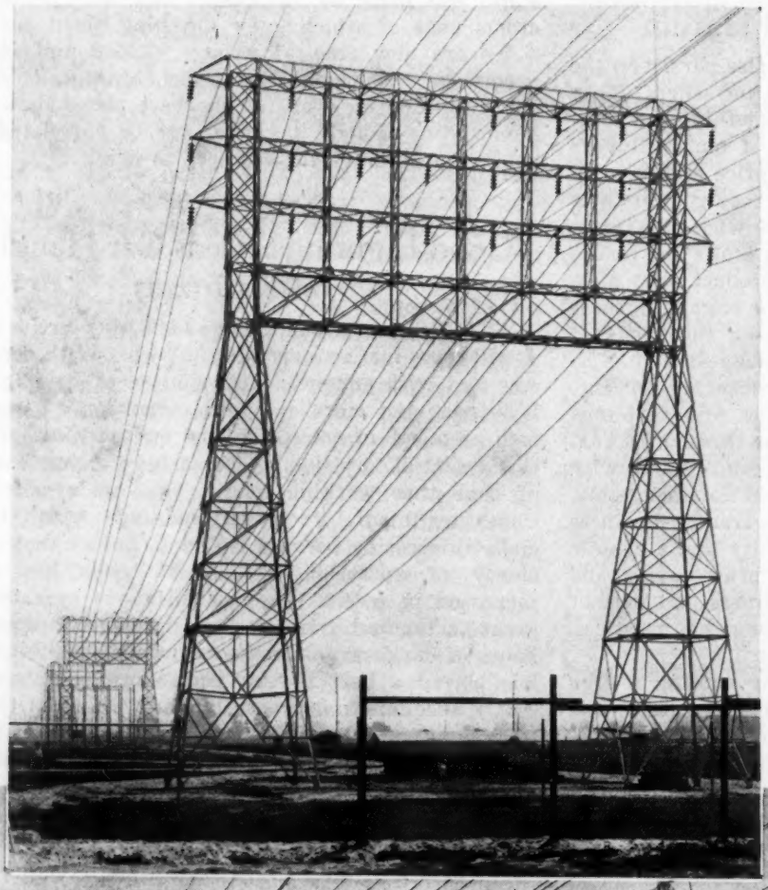
Good Lighting Speeds Car Handling on Railroads

IN THIS age of production and efficiency artificial light will come increasingly into its own. With decreasing cost and with enhanced appreciation of its importance it is receiving more and more attention. Progressive men engaged in commerce and industry are utilizing this essential to vision in decreasing the waste and loss of time that working in the shadows entails. Now comes testimonial from railroad men which is especially interesting because it is well known that the efficiency of operation of our railroads has notably increased in recent years. Continuous operation is a great factor and artificial light is essential during the hours of darkness. In many ways modern electric light has played a part in this continuous operation. Recently adequate and proper lighting has been tried out in freight yards and the results are very satisfactory.

Not long ago at a meeting of a railroad club an official made the statement that follows: "For efficient operation we are strong on light. Light does so many things. It speeds up everybody. Every one will work better under good lighting than in semi-darkness. We used to think if we switched 500 cars in the daytime, we could expect the night fellow to get away with only about 350 cars. We expect just as much now of our night men as we do of our day men, and we generally get it. This is brought about by proper lighting and cleaning up the yard. Good lighting also keeps away thieves. We are able to reduce the number of watchmen in a big yard 50 per cent by providing plenty of light." This statement from a practical man in freight-car handling is an interesting testimonial to the benefits of good lighting. Doubtless here as in many other places such lighting pays for itself many times over. Experience of its benefits are multiplying rapidly, with the result that a lighting consciousness is being awakened. There is still much to be done; but the widespread indifference and ignorance concerning the benefits of good lighting that formerly prevailed are being replaced by a full appreciation of what electricity has accomplished and can accomplish along these lines.

Multi-Circuit Towers in Southern California Distribution





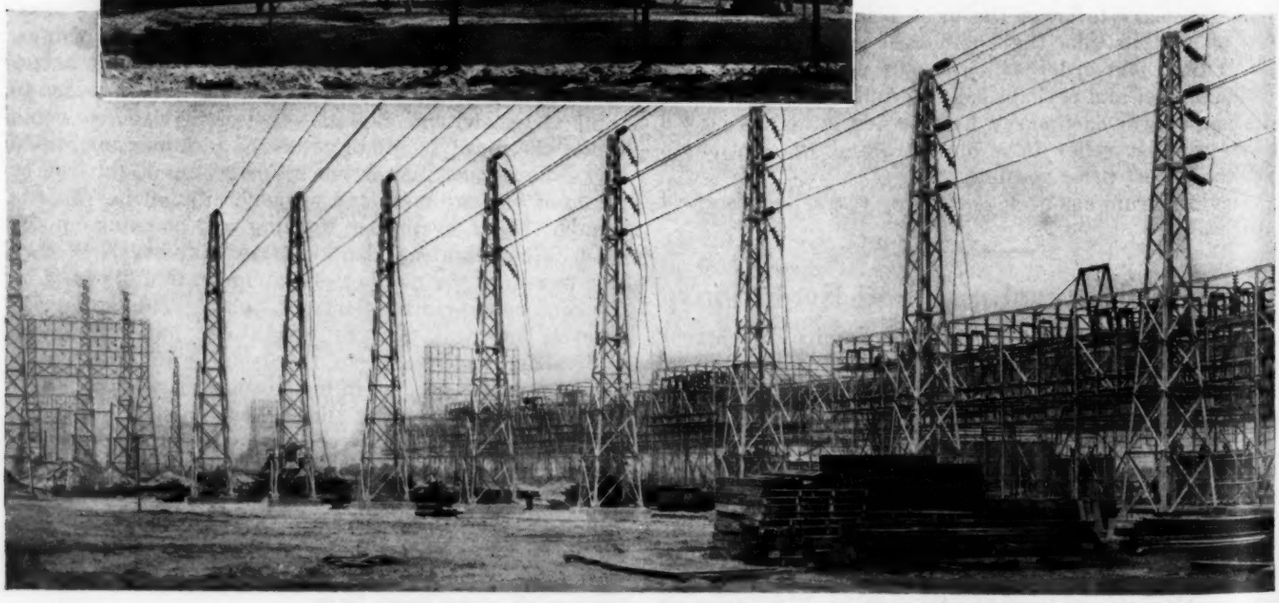
ADDITIONAL steam-generating capacity amounting to 90,000 kva. now being installed at the Long Beach steam plant of the Southern California Edison Company has necessitated construction of Lighthipe substation, a new distribution center midway between the Laguna Bell 220-kv. substation and the Long Beach steam plant. Lighthipe substation will have eighteen 66-kv. lines and four 220-kv. lines with 150,000 kva. in transformer capacity and 100,000 kva. in synchronous condensers.

Multi-circuit towers for the 66-kv. circuits solved a difficult right-of-way problem where so many lines were involved. The 220-kv. bus structures will be similar to other recent construction.

Above—Latest type of 220-kv. bus construction used by Southern California Edison Company.

In center—Multi-circuit towers carry eight 66-kv. circuits.

Below—Self-supporting steel dead-end poles for 66-kv. lines carried on multi-circuit towers.



Standardization—
Utility vs. Manufacturer

Meter Service Switches Used as Illustrative Example of Possibilities for Standardization Work Between Utilities and Manufacturers—Executive Attention Needed

By Joseph Sachs,
Chief Engineer Electrical Division,
Colt's Patent Fire Arms Manufacturing Company

THE design and construction, and sometimes even the merchandising, of the manufacturer's product are largely governed by the demands and requirements of the utility. Unless the manufacturer furnishes each embodiment of the "57 varieties" which the various units of the utility group have created by their individualistic rather than collective requirements, his product is practically excluded from this, that or the other territory because it does not comply with the specific existing requirements.

During the recent first annual meeting of N.E.M.A., R. F. Pack, then president of the N.E.L.A., presented an address on "Constructive Thoughts Toward Co-operation" and urged standardization of apparatus and appliances produced by the manufacturer. This thought undoubtedly is accepted unanimously. N.E.M.A. (and its predecessors, the Power Club, the A.S.M.E. and E.M.C.) recognizes the importance of standardization and has given much talent, time and energy to the development of standards tending toward technical and economic betterment of utility and manufacturing conditions. Those comprising this association have been working to such standards for some time.

The manufacturer (through N.E.M.A.), having well-established standardization machinery, continues to evolve standards for his product and is desirous of co-operating with the utility, that they may be in accord with the collective views of both interests. The utility, through N.E.L.A., may justly claim equal desire and effort to standardize the apparatus, appliances and practices entering into its field of electrical activities. With the same underlying basic thought, it would appear possible to arrive at uniform design, operative characteristics and practice requirements acceptable to the individual interests comprising these two groups. Requirements for apparatus or appliances having a common function should be reduced to a uniform basis, and lack of observance of the adopted standards of either group, by individual member units, should be eliminated. Regrettably, present requirements vary with the peculiar demands of individual utilities. Frequently these appear to have no more substantial foundation than that they are different and that those who impose them are swayed by individual rather than by what might be collective conclusions.

Illustrative of this "every man for himself" policy is the present situation in connection with entrance and meter service installation practice. The appliances and methods used where the utility's product passes over the counter to the consumer, the consumption recorded by the meter—the utility's cash register and the point at which the consumer's supply is controlled—are a highly important, although perhaps not impressive, link in the chain which brings the utility's commodity to the customer's premises.

Here is an instance of almost complete unanimity of opinion on the broad proposition and striking diversity in individual practice. The protected entrance and meter service installation, combining switch, fuse and means for the mechanical protection of conducting service parts and for facilitating meter testing, has been so generally adopted that it has become substantially standard practice. However, such switches, produced in accord with utility requirements in various sections, differ in arrangement of switch and fuse parts; connection sequence of line, switch, fuse, meter and load; accessibility or non-accessibility of service side fuses; manner of obtaining access to such fuses; connection and disconnection of the fuses from the line only, or from both line and load, by the switch; size of cabinets; methods of grounding and manipulating the neutral circuit wire and parts; relative positioning and arrangement of the switch and fuse parts; design and manner of arrangement of the meter-testing elements when provided; knockout sizes and their arrangement and location in the inclosing cabinet; method and manner of co-operatively arranging the meter with the cabinet to provide for mechanical protection, etc.

Those whose differing requirements make it necessary for the manufacturer to design, produce, stock and merchandise this diversity of styles and forms may not be impressed with the thought that their specialized requirements are handicaps in the ultimate attainment of an economic situation much desired by the utility—safer, better and less expensive electrical installations—as well as a more satisfactory manufacturing and merchandising condition for the manufacturer.

The manufacturers' catalogs of inclosed entrance and meter service switch devices reveal some rather startling facts in confirmation of the claim that diversity rather than uniformity is the basis on which the situation has progressed. Each of several manufacturers produces and lists a score or more varieties, differing in the features enumerated, but generically similar. Here are the requirements of a few individual utilities (or groups):

(A) Fuse controlled by switch and both connected between line and meter, the fuse being inaccessibly inclosed except to authorized persons. (Known as Type B.)

(B) Fuse connected between line and meter, uncontrolled by the switch, which is connected after the meter, the fuse

being inaccessibly inclosed, except to authorized persons. (Also known as Type B.)

(C) Fuse, controlled by the switch, connected on service side of meter and arranged to be accessible when disconnected by moving switch to off-position but without permitting access to live service-side parts. (Known as Type A.)

(D) Modifies the accessible service-side fuse arrangement *(C)* so that disconnection of fuse by switch is at both ends, entirely freeing it from the load as well as the line wire. (Known as Type AA.)

(E) Uses a connection sequence of line, switch, meter, fuse; effort is being made to adopt this arrangement throughout one entire state.

(F) Goes to the extreme in adopting a connection arrangement of line, meter, switch, fuse.

(G) Takes exception to combining, in a single appliance, the distribution control devices with the service switch, thus handicapping economic, compact and simple installation.

(H) Requires that switch, fuse and all other parts are on outwardly facing surface of block, and refuses to accept any other arrangement even though hundreds of thousands of devices of another construction are in satisfactory service.

(I) Service and load-side test disconnect links must be provided and mounted side by side so that service to the meter is from the outer instead of the inner links on the block.

(J) Requires just the opposite of *I*, insisting that test links to the meter be centrally located and those from the meter on the outside.

(K) Uses inclosed, externally operated meter service switches, but is indifferent to manner in which meter is protectively related with cabinet, consequently destroying one of the important basic advantages of such a system.

(L) Insists on securing proper protective relationship between meter and cabinet, but requires an insulating protective fitting.

(M) Openable test elements for appliances above 30 amp. must be bolted, whereas for 30 amp. they must be of the switch type.

(N) Requires switching neutral, notwithstanding simplicity and generally satisfactory use of solid non-switching and non-fused arrangement of neutral conducting parts.

(O) Must have main fuse connection ahead of meter and another fuse after meter, fuse ahead of the meter being sealed and inaccessible, whereas the load-side fuse is accessible.

(P) Ignores advantages of service and load-side fusing (National Electrical Code requirements under some conditions) and is indifferent as to breaking of cabinet seals by customer to get at main service-side fuses inside cabinet.

The list might be considerably extended, since among those using some particular above-cited arrangements, there will be diversity of requirements as to other features. For instance, in Group C there are various individual requirements as to the cabinet knockouts, arrangement of test links, methods of grounding neutral, relative arrangement of the fuse, switch and test link parts, etc. The situation, as it stands today, indicates a tendency away from rather than toward standardization.

AN INSTANCE OF STANDARDIZATION

It is not intended to create the impression that no effort has been made or result attained toward standardization of at least certain elements entering into the meter service installation problem, even though the broad situation as to style, type and arrangement of parts and connection sequence of the meter service switch is in a seemingly chaotic condition. The N.E.L.A. meter committee, co-operating with the meter manufacturers and the manufacturers of meter service switch devices (represented by an N.E.M.A. committee), has developed a generally acceptable arrangement and size for meter terminal chambers that have been adopted as standard and are already being embodied in meters of various manufacturers. With meters of different makes having terminal chambers of the same contour and size, the variety of meter-protecting end walls or trims previously required are eliminated. A single end wall with a standardized opening now serves for use with any of the different makes of standardized terminal chamber meters and constitutes an important step forward. The small size single-phase meters with such standardized terminal chamber arrangement are being produced and beneficial results are already noted. The work is being carried along in the larger and polyphase sizes. N.E.M.A. through its committee on meter terminal chamber standardization, found willing and eager co-operation in the N.E.L.A. meter committee.

ANALYSIS OF THE FACTS

Surely there must be some one combination of switch, fuse, meter-testing, meter-protecting, cabinet and correlated parts that would function satisfactorily and provide the essentials for practically every utility now requiring its own special arrangement. Those requiring *C* presumably came to their conclusion because of certain features that they believe to be desirable and that experience has shown to be worthy of continued use. The *A* requirement is based on quite the opposite concept of what a meter service switch should provide. In one instance, the service-side fuses must be safely accessible to the consumer while preventing access to live parts; in the other, access is considered absolutely undesirable and unwarranted at any time and irrespective of condition. Both of these antipodal concepts cannot be right, assuming that basic service conditions are much alike. If sealed fuses provide the best arrangement, the advantages should be evidenced in any service anywhere. If, on the other hand, it is of advantage to provide means whereby the utility is relieved of the servicing entailed in the sealed fuse arrangement, then the accessible service-side fuse device should be the generally used arrangement. Undoubtedly there are peculiar special conditions encountered by all utilities where certain arrangements of one kind or another may be warranted. It is believed that these are rather in the minority as compared with the general service situation, which each and every utility must handle in very much the same way. It appears quite logical to concede that one or the other of the above-mentioned radically different basic arrangements could be selected as mutually satisfactory.

Similar analysis may be made of the other requirements. Unifying these should be readily accomplished, because they are of more detailed character.

Familiarity with the situation as herein exemplified naturally prompts the thought that utility chief executives are sometimes not entirely familiar with such conditions. The chief executive of a successful utility surely grants the importance of developing to the highest economic and technical efficiency and efficacy that part of his complete business machinery system and practice at which the utility's commodity is delivered to the buyer and the amount of the purchase recorded. However, it frequently appears as if service and meter departments were regarded with almost complete indifference and their technical operation and destinies were directed by men thoroughly capable, but not vested with authority to speak conclusively and finally on matters of broad policy. Under such conditions, conclusions may have a dominating technical basis without sufficient counterbalancing of economic, commercial, public relations and other non-technical considerations.

Protection from Lightning—I*

Laboratory and Field Investigations at Last Give Definite Data on Lightning Phenomena—Application to Transmission Line and Oil Tank Protection

By F. W. Peek, Jr.
Consulting Engineer General Electric Company

AN INVESTIGATION was undertaken to determine the voltage, current, energy and other characteristics of lightning; the magnitude and characteristics of lightning on transmission lines; the value of protective schemes, and the strength of insulation and insulators when subjected to lightning or other transient voltages. The general method followed has been to study lightning in the field and then go to the laboratory and attempt to reproduce the effects on models with a lightning generator.

The impulse or lightning generator-giving impulses of a known wave shape have made high artificial lightning voltages possible because they are excited at 60 cycles alternating current and do not require a rectifier. Their limit is the available alternating-current voltage supply. The wave reaches its maximum value in a few millionths of a second and after about five microseconds is reduced to about half voltage. It is thus in effect a wave of abrupt front about a mile long. Investigations have been made with this generator up to 2,000,000 volts. The current is of the order of 10,000 amp., and the energy is 2,000 watt-seconds, while the power may be several million kilowatts. The appearance of the discharge and the destructive effects are similar to those of natural lightning: fire may be set, metal conductors disappear; wood may be blown apart, discharges in water or oil produce explosive results, etc. The lightning generator has been an almost direct means of measuring the voltage of natural lightning. This was done in the following manner and it is typical of the other work:

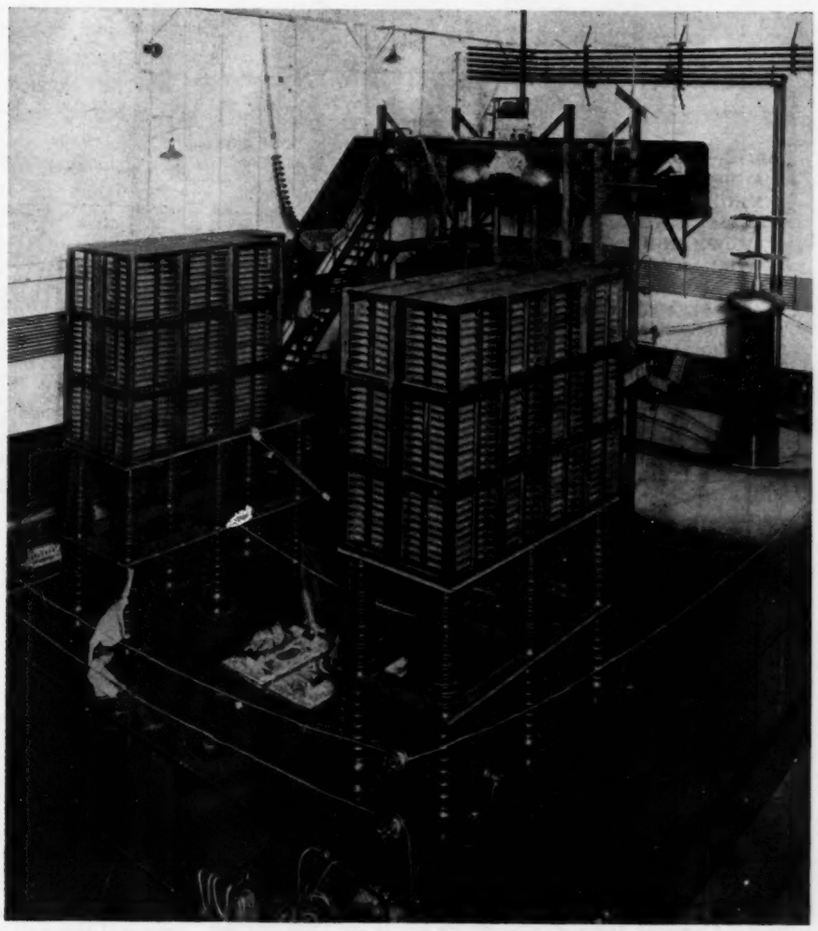


FIG. 1—2,000,000-VOLT LIGHTNING GENERATOR

When a lightning flash occurs in the vicinity of a transmission line, a certain percentage of the voltage appears on the line by electrostatic induction. The voltage of the flash cannot be measured directly, but the voltage induced upon the line can be measured. Lightning voltages of over 500,000 induced on lines were measured in Colorado, and during the past year voltages of over 1,800,000 have been accurately measured. Much higher voltages were either measured or estimated from insulator flashovers.

Models were made to scale representing a cloud and an insulated line for certain observed conditions. By means of the lightning generator it was found that when a flash occurred from a given model cloud, 1 per cent of its voltage was induced on the model line. But it was known by observation that the voltage induced on an actual line, under similar conditions, was of the order of 1,000,000. If this was 1 per cent of the voltage of the actual lightning, the voltage of the flash must have been 100,000,000 volts. This gives an average gradient of 100 kv. per foot and corresponds approximately to needle gap values of 150 kv. per foot.

*Paper presented before the International High-Tension Conference, Paris, July, 1927. Part II will be published in the next issue of the ELECTRICAL WORLD.

It thus appears, by approximately direct measurements, that the order of voltage of a lightning stroke from a cloud to the ground is 100,000,000 and that the maximum gradient as limited by the dielectric strength of the air is 100 kv. per foot. It can be concluded that with a resistance as low as 100 ohms the discharge is highly damped. *Measurements indicate that lightning is generally non-oscillatory. The duration is often a few microseconds, though it may be much longer. The energy is of the order of 4 kw.-hr., while the current is of the order of 80,000 amp.*

This value of current has been checked to some extent. For instance, in one case, when a radio antenna was struck, a steel spring in one end of the antenna was just melted. Current time curves were made on this spring by short circuiting a large generator.

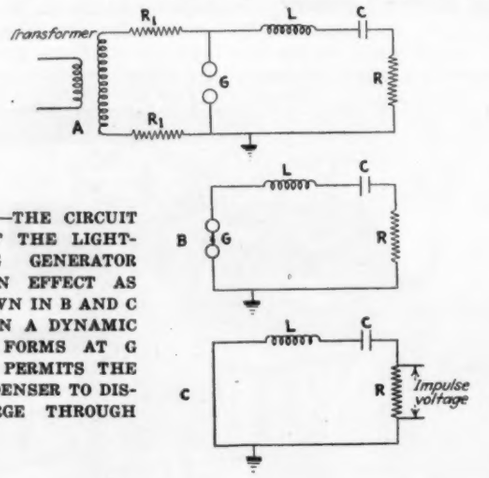


FIG. 2—THE CIRCUIT A OF THE LIGHTNING GENERATOR IS IN EFFECT AS SHOWN IN B AND C WHEN A DYNAMIC ARC FORMS AT G AND PERMITS THE CONDENSER TO DISCHARGE THROUGH IT

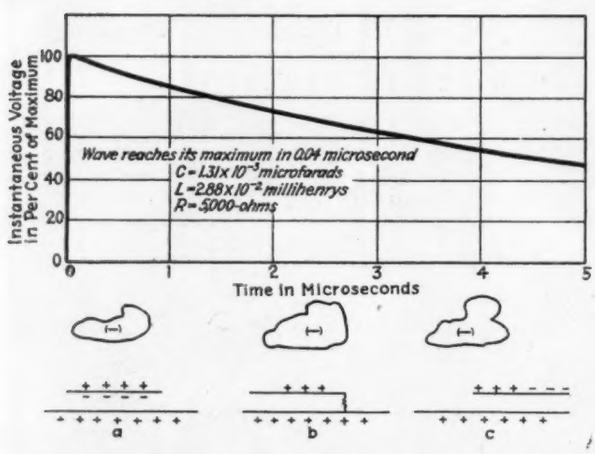

Instantaneous Voltage in Per Cent of Maximum
Wave reaches its maximum in 0.04 microsecond
C = 1.31 x 10⁻³ microfarads
L = 2.88 x 10⁻² millihenrys
R = 5000 ohms
Time in Microseconds
a
b
c

FIG. 3—WAVE NO. 1 OF THE LIGHTNING GENERATOR (AT LEFT)

Assume a negatively charged cloud. A short, well-insulated wire situated along an equipotential surface takes the potential of the space in which it is located and becomes (+) on the side nearest the cloud and (—) on the side farthest from the cloud (Fig. 5*a*). When the cloud discharges, the two charges on the wire go together and the potential of the wire becomes zero. In this case it is possible for a spark to occur between an insulated wire near it but differently located in space, even though the cloud does not discharge. What is usually known as electrostatic induction, however, occurs as follows:

Assume the line wire in Fig. 5*b* to be poorly insulated or grounded or to extend beyond the cloud as in Fig. 5*c*. The negative charge leaks away. The wire becomes positively charged, while its potential becomes zero. When the cloud discharges, the bound charge on the wire is released, which causes it to take a potential above ground with a sign opposite to that of the cloud. The wire reaches its maximum potential at the instant that the cloud reaches zero. If the discharge takes place very rapidly or if the line is short compared with the cloud, the potential that the wire assumes is approximately equal to its height above ground multiplied by the voltage gradient. The gradient depends upon the position of the cloud with reference to the wire. The maximum voltage that the line can attain is equal to 100,000 times its height in feet above ground, or 330,000 times its height in meters. This is practically a direct stroke. In general the voltages are $V = g\,\alpha\,h = Gh$, where g is the gradient and h is the height. The gradient depends upon the distance of the cloud from the wire. In the case of long transmission lines, α would be less than unity, its exact value depending upon the rate at which the cloud discharges. This follows because in slowly discharging clouds the charge is dispersed over the line for a considerable distance before the cloud becomes completely discharged. Measured values of g, or apparent gradients, G, as high as 50,000 volts per foot have been observed on long transmission lines in practice. This means that at least some clouds must discharge at an extremely rapid rate or within a few microseconds.

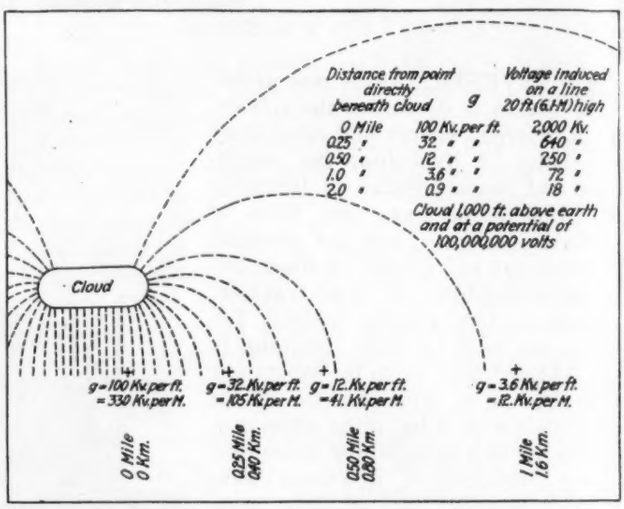

Distance from point directly beneath cloud
g
Voltage induced on a line 20 ft. (6.1 M) high
0 Mile 100 Kv. per ft. 2,000 Kv.
0.25 " 32 " " 640 "
0.50 " 12 " " 250 "
1.0 " 3.6 " " 72 "
2.0 " 0.9 " " 18 "
Cloud 1,000 ft. above earth and at a potential of 100,000,000 volts
Cloud
g = 100 Kv. per ft. = 330 Kv. per M.
g = 32 Kv. per ft. = 105 Kv. per M.
g = 12 Kv. per ft. = 41 Kv. per M.
g = 3.6 Kv. per ft. = 12 Kv. per M.
0 Mile 0 Km.
0.25 Mile 0.40 Km.
0.50 Mile 0.80 Km.
1 Mile 1.6 Km.

FIG. 4—VOLTAGES INDUCED BY LIGHTNING ON TRANSMISSION LINE

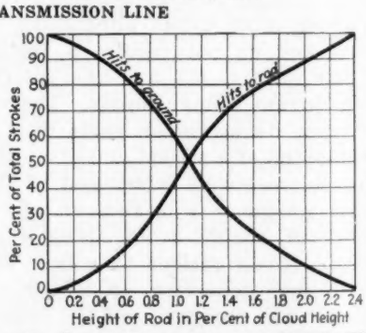


FIG. 6—DIVISION OF HITS BETWEEN ROD AND GROUND FOR DIFFERENT HEIGHTS OF ROD

FIG. 5—DURING A THUNDERSTORM THE AIR BENEATH A CLOUD IS UNDER ELECTRICAL STRESS, AS SHOWN AT LEFT

When a grounded conductor is placed near and parallel to a transmission line, the maximum voltage is reduced. Tests on models show this very well. These tests were made by placing a model line under the model cloud and

measuring the induced voltages with and without a ground wire.

The tests on models show that it is important to "ground" the ground wire at every pole. When good grounds cannot be made, the ground wire is not so effective. The tests further show that the effect is the same whether or not the neutral of the system is grounded or what the nature of the discharge is. It is believed that the ground wire should be either of non-magnetic material or of a conductor with the outer surface of non-magnetic material. In general, the nearer the ground wire is to the line conductor the more effective it is. With the same spacing to the conductor the effectiveness increases with the height of the line. It is desirable to place the ground wire above the line conductors to protect against direct strokes. The size of the ground wire should be approximately the size of the conductors. In addition to reducing the induced voltage, the ground wire reduces the energy induced on the line to about one-half and very greatly reduces the energy of direct hits.

In practice it is probable that at best one ground wire would reduce the induced voltage to one-half, two to one-third and three to one-fourth.

TRAVELING WAVES CHANGE ENERGY RELATIONS

When the charge is released on the line, a wave of energy starts to move in both directions at the velocity of light, or about 1,000 ft. per microsecond. At first this energy is in the static field and the voltage may go to the value determined by the height of the line, if the insulation breakdown is not exceeded. When the wave is well under way, however, there must be both current and voltage with half of the energy stored in the magnetic field and half in the electrostatic field. The voltage must, due to this cause, drop to half value. As the wave proceeds along the line energy is dissipated in corona and resistance losses. If a point of increased surge-impedance is encountered, part of the wave is reflected and part goes on at an increased voltage. On the other hand, if a point of decreased surge-impedance is encountered, the unreflected voltage is decreased. If a wave passes through a resistance of the surge-impedance of the line, there is no reflection. An inductance in series with the line may cause dangerous voltages unless it is shunted by resistance. There may, for instance, be much higher voltages where a wave leaves an inductance than where it enters. When a wave reaches the end of an open line, the current stops; hence the voltage must double. Eventually, if the line is well insulated, an oscillation is produced of the natural period of the line.

WHERE LIGHTNING STRIKES AND THE CHANCES OF BEING STRUCK

Research on models in the laboratory shows that the lightning from a cloud overhead does not always strike the highest object or rod unless its height is 2.5 per cent of the cloud height. The division of hits is about equal between cloud and ground when the rod is 1.1 per cent of cloud height. The chance of being hit is less when the cloud is not directly overhead. Lightning then either strikes the rod or strikes some distance away. There is a protected area around the rod with a radius equal to about four times the height of the rod over a wide range of conditions where no ground hits occur. This has been studied by placing the rod or rods on a paper target and recording the hits by the marks on the paper. This study has been made with the cloud directly over the rod and with the cloud some distance away from the rod; clouds of kinds varying from points to spheres and flat plates have been used; the voltages were varied from (+) and (—) direct current, to impulses, 60-cycle alterating current and transients, always with the same general result. There is, however, one important factor that affects the protective ratio—that is, cloud height compared with rod height. When the cloud is high compared with the rod, the protective ratio may be four or more. As the cloud height is decreased the protective ratio becomes less. Its minimum value is one when the rod and the cloud

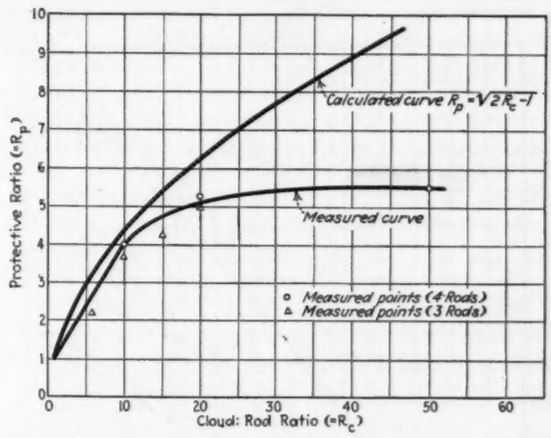


FIG. 7—RELATION BETWEEN RATIO OF RADIUS TO ROD HEIGHT (R_p) TO RATIO OF CLOUD HEIGHT TO ROD HEIGHT (R_c)

are the same height. The value of four is generally reached when the cloud is ten times the height of the rod. The direct-current tests were made up to about 350 kv. above ground. An interesting fact about the direct-current test is that the rod is most effective when the cloud is negative; for a (+) cloud the protective ratio of four is reached for a higher value of cloud-rod ratio than ten—in fact, about twenty. Tests were also made with wires under the cloud. Either the wire is hit or the cloud is some distance away. For a single wire, the ground is never hit nearer the plane of projection of the wire than about four times its height above ground.

A similar test was made on paralleled ground wires. It was found that the ground between the wires was never hit when the separation of the wires was not greater than about four times their height. Both these ratios would apply for a cloud-rod ratio of ten and are subject to variation with cloud height as given in Fig. 7. The laboratory tests also show that a ground wire over a transmission line is struck 98 per cent of the time, while the conductors are struck the remaining 2 per cent. This is an important factor in favor of the ground wire.

Tests similar to the single-rod tests were made with three or four rods symmetrically arranged about a circle or with four rods on the axes of an ellipse. It was found that the area inside of the circles or ellipses was protected from direct hits if the heights of the rods were such that their protective circles overlapped.

Another interesting test showed that a hit can never occur within a circular tank when the height of the tank is greater than one-tenth its diameter.

When two conducting rods are placed directly under the cloud, the higher one protects the lower one. If the higher rod is drawn away from the lower one and away from the plane of protection of the storm center, the lower one is protected until a critical distance is reached, when hits are divided between the rods. When the separation is increased, the hits go to the lower rod.

The following experiment seems to explain some peculiar effects noted in practice. If a high wooden rod and a shorter metal rod are placed close together under a storm center, the metal rod is always struck. The wooden rod has no effect. If the wooden rod is dampened so that it becomes a conductor of high resistance, it is struck in preference to the metal rod. However, there is an immediate side flash from the wood to the shorter metal rod. When the wood is made decidedly conducting, it acts like a metal rod and the discharge follows down its surface. The explanation is quite simple: The high-resistance wood was conducting enough to carry the small charging current and thus determine the direction of the stroke. As soon as it was hit, however, its resistance was too high to carry the lightning current; it thus side flashed to the rod. This explains why it is dangerous to stand under a tree; why chimneys are struck with disastrous side flashes; why wooden flagpoles are struck and splintered. It also shows why a lightning rod up to the chimney top does not increase the hazard of being struck and in case of a direct hit carries the current and prevents destruction.

Other peculiar occurrences are explained:

Assume a tall, dry, wooden church and a clump of trees lower than the church. A tree is struck. About half way down the tree is very badly shattered and blown apart. An examination shows that the lightning flash missed the high church and appears to have struck underneath the branches of the tree. A simple explanation is as follows: The church was too dry to influence the field. The tree was conducting enough to determine the path of the discharge and the top sappy, wet branches were able to conduct it. The trunk of the tree was too dry to carry the current and caused the tree to split. Such results were shown on a model.

NEEDLE GAP SPARKING VOLTAGES

The typical discharge from the lightning generator at 1,500,000 volts (maximum) between points has a zigzag path and characteristic side flashes of lightning. The lightning sparkover curve for needle gaps shows that for the particular impulse used it requires a voltage approximately 2.25 times the 60-cycle voltage to sparkover a given gap. The author has called the ratio of the impulse voltage to the 60-cycle voltage the "impulse ratio." The impulse ratio here is 2.25. This is due to time lag and conforms to previous work of the author at lower voltages.

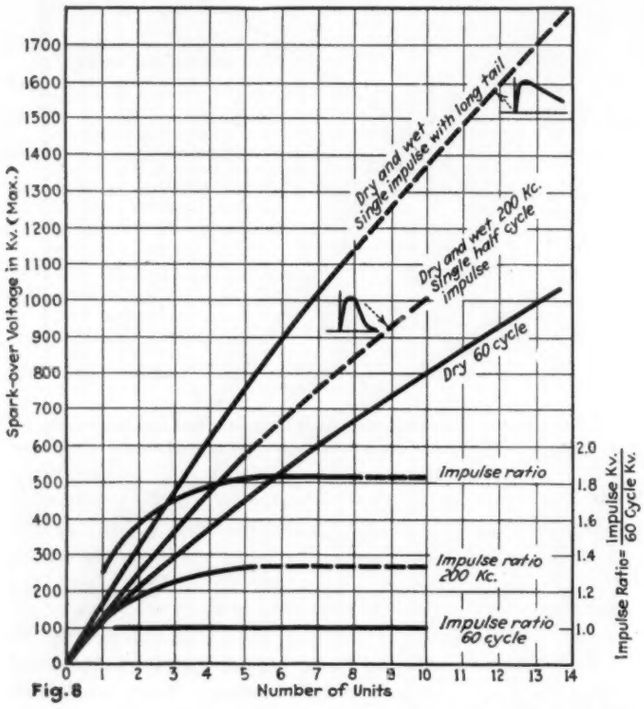

Spark-over Voltage in Kv. (Max.)
Dry and wet Single impulse with long tail
Dry and wet 200 Kc. Single half cycle impulse
Dry 60 cycle
Impulse ratio
Impulse ratio 200 Kc.
Impulse ratio 60 cycle
Impulse Ratio = Impulse Kv. / 60 Cycle Kv.
Number of Units

Fig. 8

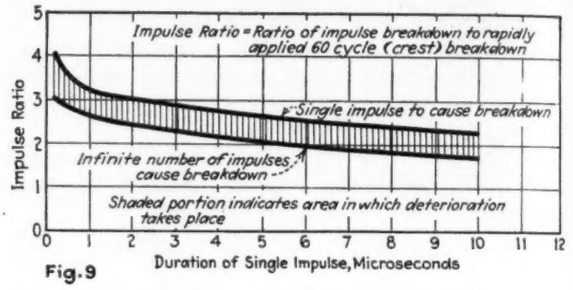

Impulse Ratio = Ratio of impulse breakdown to rapidly applied 60 cycle (crest) breakdown
Single impulse to cause breakdown
Infinite number of impulses cause breakdown
Shaded portion indicates area in which deterioration takes place
Impulse Ratio
Duration of Single Impulse, Microseconds

Fig. 9

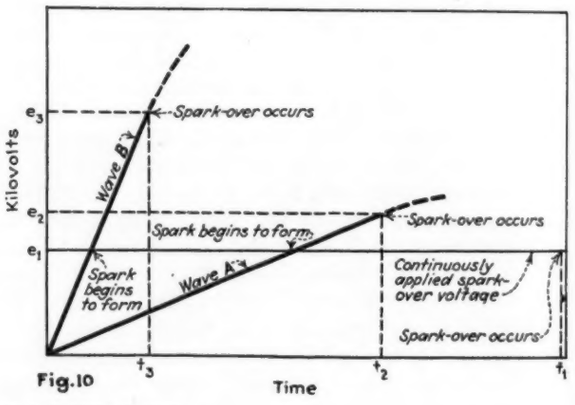


Fig. 10

IMPULSE AND HIGH FREQUENCY EFFECTS DIFFER

Fig. 8—Comparison of 60-cycle and lightning sparkover voltages on suspension insulators (top of string grounded)

Fig. 9—Impulse ratio and cumulative effect of impulses. Typical curve for one insulation

Fig. 10—Diagrammatic illustration of why lightning flashover voltage is higher than continuously applied voltage

THE SPHERE GAP SPARKING VOLTAGES

While the impulse sparkover voltage of the needle gap varies with the wave shape of the impulse and is always higher than the 60-cycle sparkover, the sphere gap is very little affected even for quite steep waves. The sphere gap thus offers a means of measuring transient voltages over a considerable range. However, in measuring such voltages, it is important to have limited series resistance. Series resistance above a critical value will give the sphere the characteristics of the needle gap. It takes time to charge the capacity of the sphere through the resistance.

The effect of series-resistance changes with the wave

shape. A resistance in series with a sphere may be used, therefore, to indicate the duration of a transient, while the wave front may be measured by the voltage across an inductance.

LINE INSULATOR FLASHOVER PHENOMENA

Line insulators have a lightning flashover voltage that is higher than the 60-cycle flashover voltage. The lightning flashover voltage is practically the same whether the insulators are wet or dry. Fig. 8 gives 60-cycle and lightning flashover voltages of suspension strings of different lengths. The upper curve was made with the wave shown in Fig. 3, and it is believed that it corresponds very closely to severe lightning strokes. Although this wave was selected several years ago on a theoretical basis, sparkover points obtained recently for strings of insulators composed of four units and of fourteen units, for very severe lightning on an actual line, fell right on the curve.

Lightning prefers to go over a surface rather than directly between points through air or oil. For instance, it will spark about a 20 per cent greater distance over an insulator string measured directly from bottom pin to top cap (not along the surface of the units) than directly between points in air. For this reason it is important to make the stress over the surface uniform. The insulator grading shield is very important from this standpoint.

INSULATION TIME LAG

Both oil and solid insulation have time lag and the lightning strength may be several times the 60-cycle strength. It is thus important to know the impulse ratio and lightning breakdown of insulation and apparatus. The distribution of lightning voltages is important in apparatus. A typical insulation curve for impulses of different durations is given in Fig. 9. Voltages in excess of about 80 per cent of the single stroke breakdown value will cause deterioration and eventual failure if a sufficient number of impulses are applied. Is seems of importance to review briefly the reason for time lag.

A fixed minimum voltage is required to sparkover a given gap when the time of application is not limited. Energy is necessary to rupture gaseous, liquid and solid insulation; this introduces a time element.

Referring to Fig. 10, the sparkover voltage of a given needle gap is e_1 and always practically constant, if the time of application is not limited. Sparkover may take place after the continuously applied voltage, e_1, has been on for some time, t_1. If a voltage increasing at a rapid rate, as represented by A in Fig. 10, is applied, sparkover will not take place when the continuously applied sparkover voltage, e_1, is reached, because the time, t_1 is required to produce the sparkover at this voltage. The spark will being to form when the voltage reaches the value e_1, however. The voltage will, therefore, rise above e_1, and sparkover will take place after the time t_1 has elapsed and the voltage has risen to e_2. When the voltage is applied at a more rapid rate along wave B, the spark, as before, will begin to form when voltage e_1 reached. The voltage will continue to rise and reach the value e_2 during the time t_2, before the sparkover occurs. Thus, on account of the time lag, when voltage is applied at a very rapid rate, as by an impulse, sparkover does not occur when the continuously applied breakdown voltage is reached. The voltage "overshoots" this value during the time that rupture is taking place. The excess in voltage is greater, and the time lag less, the greater the rate of application. The time lag for any given gap or insulation has thus not a fixed value, but depends on the wave shape of the impulse or rate of application of the voltage. In making a study of such phenomena it is necessary to use certain definite wave shapes. The continuously applied (60-cycle or direct current where heating does not occur) sparkover voltage is the lowest voltage at which sparkover can take place.

The time required to sparkover a gap varies with the spacing and shape of the electrodes. For a given 60-cycle voltage setting the time required to form a spark is greatest for gaps between points and least for gaps between well-rounded surfaces. For spheres the time lag is so small that discharge takes place before the impulse voltage can rise appreciably above the continuously applied or 60-cycle sparkover voltage.

The needle gap requires the maximum time of any gap, as considerable air must be ionized before sparkover can result. Another way of considering it is that the corona increases the capacity and places resistance in series with it as it forms. It requires time to charge a condenser through resistance.

On the other hand, spheres are very little affected, because corona does not precede sparkover and the discharge is small and confined to a short path. The electrostatic field is very nearly uniform and ruptures start everywhere along the path between the electrodes at approximately the same time.

CORONA FORMATION

Lightning voltages cause corona in the same manner as continuously applied voltages. Corona produced by lightning voltages of less than a microsecond duration can be readily seen. It is also easy to tell at a glance whether the impulse is positive or negative. The author has found that, in general, corona produced by impulse voltages follows the same law as corona produced by continously applied voltages.

Union Colliery Uses Portable Mine Substation

A PORTABLE mine substation which can be moved to a new location in approximately eight hours has been installed by the Union Colliery Company in its mine at Dowel, Ill. Operation of this mine necessitates the frequent moving of the converter substation in order to maintain the desired voltage of the direct-current supply at the mining face. It is estimated that it will be necessary to move the substation every three to six months.

The substation includes a General Electric, semi-automatic, 200-kilowatt synchronous converter which with its transformer and control equipment are mounted on trucks which are of the same gage as the mine tracks. The converter base has structural steel projections for attachment to the trucks. The projections can be detached after the set has been moved, and the unit is then bolted and grouted to the substation floor.

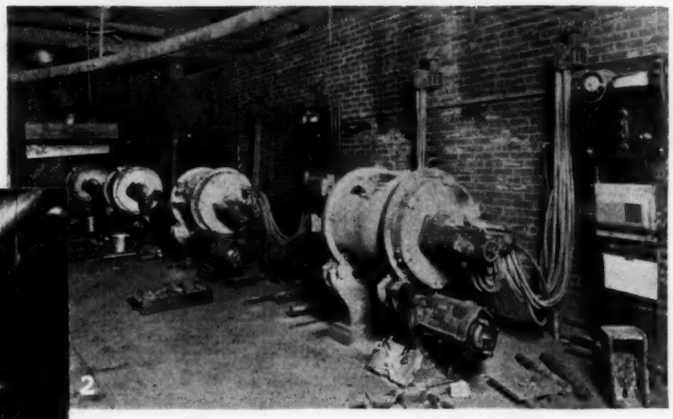
In designing this substation the factor of headroom was found to be important, it being necessary to keep within a limit of 4 ft. 6 in. Ventilation is also an important factor and the substation rooms are so arranged that they will be ventilated by intake air.

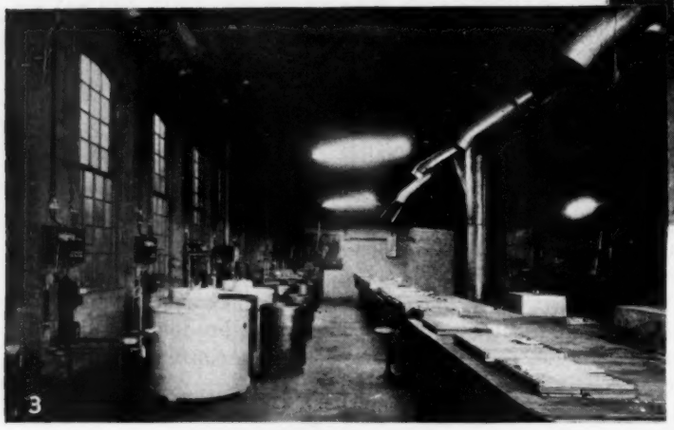
No. 1. Battery of fifteen linotypes in new plant of Salem (Mass.) *Evening News*, each equipped with a 1,500-watt heating unit.

No. 2. Battery of four 100-kva., 350-lb brass-melting furnaces which embody latest ideas in departmental symmetry of arrangement.

Multiple-Unit Installations of

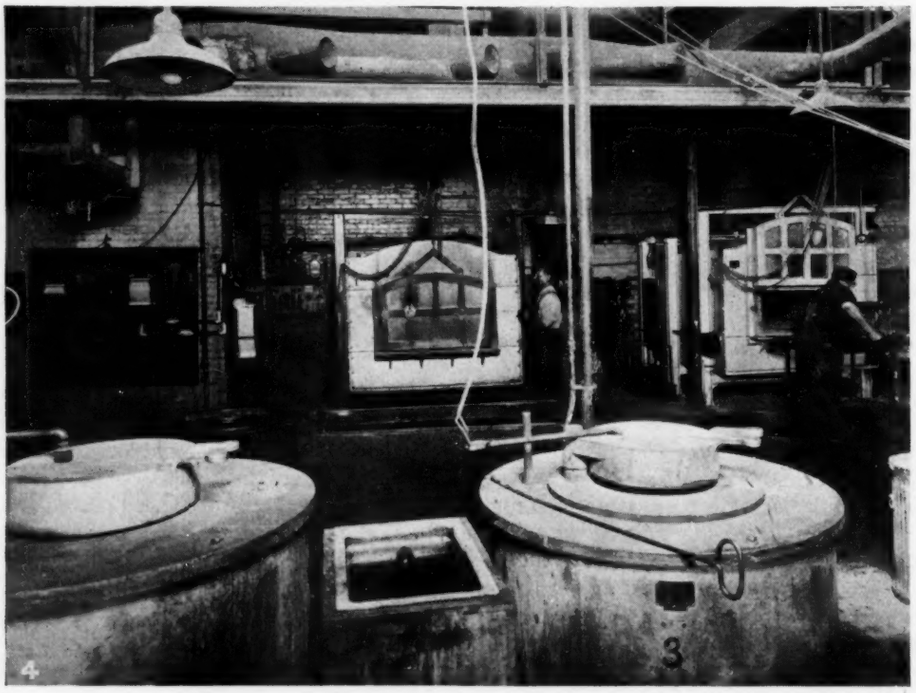
Industrial Heating Applications





NO BETTER evidence of the increasing economic benefits of industrial electric heating is asked by executives than multiple-unit installations, whether made initially or through repeat orders. A decided trend is apparent today on the part of manufacturers and commercial houses to adopt electric heating for specialized processes so that symmetrical expansion of facilities can be made. A few examples of this tendency are illustrated.

No. 3. Battery of eleven 20-kw. lead-pot furnaces in tool department of large Eastern factory. Five larger units were on order when the photograph was taken.



No. 4. Batteries of lead and cyanide pots aggregating 190 kw. in Cushman Chuck Company's plant, Hartford, Conn.

Measurement of

Voltage Distribution Over Insulators*

Neon-Tube Potentiometer Employed for Studying Potentials—Various Steps in Investigation and Difficulties Overcome—Potential Distribution at Sub-Corona Voltages—Benefits of Shielding

By Frank E. Reeves

A FAIRLY precise method for determining voltage distribution along a string of porcelain insulator units subjected to high voltage is desirable in the design of string insulator units, high-tension line hardware, shells of pin-type insulators and high-voltage bushings. Research in voltage distribution in insulator strings has formerly yielded only approximate values.

Attempts to measure voltages across the individual units of a string by ordinary methods meet with numerous difficulties. First, the current through an insulator is very small and the current drawn by an ordinary measuring instrument is either greater than or comparable with the former, so that the currents and consequently the voltages are disturbed. Also, the electrostatic field surrounding a string of insulators subjected to high voltage is so strong that a conductor carrying even a small current has a tendency to distort this field and affect the voltage distribution. The ideal measuring instrument would be one that would draw no current, and if leads were necessary, the most accurate measurement could be obtained when the leads were inserted along electrostatic lines of equal potential.

Potentiometer Method Used

The ideal method is approached when the potential of the connections between the insulator units is balanced against the potential on a high-voltage potentiometer so that no current flows through the lead to or from the point whose potential is being measured. This creates no disturbance in the insulator currents, and if the apparatus that is applied to the insulator string is small and properly designed, a negligible distortion of the electrostatic field will result and a fairly accurate determination of the condition can be made.

W. D. A. Ryan of the General Electric Company has used the potentiometer method for determining the voltage distribution along a string of suspension insulators. His potentiometer consisted of a number of short sections of rubber hose connected by brass couplings, which served as taps on a resistance obtained by passing a slow stream of water through the hose. A wire strung between brass pins on the ends of two sticks served as a galvanometer. The method of operation was to place one of the probe sticks on the insulator string on the point whose potential was to be measured and run the other one up and down the hose until a connection was reached where no spark was obtained upon making or breaking contact. This was taken as a balance point, and its potential was estimated by assuming that the voltage gradient along the hose was uniform, and consequently a simple proportion gave the desired potential. Measurements made with this device were not precise, because there were not enough steps on the potentiometer and the spark method for indicating a balance was not sufficiently positive.

The potentiometer resistance used in the measurements described below was made up of a number of

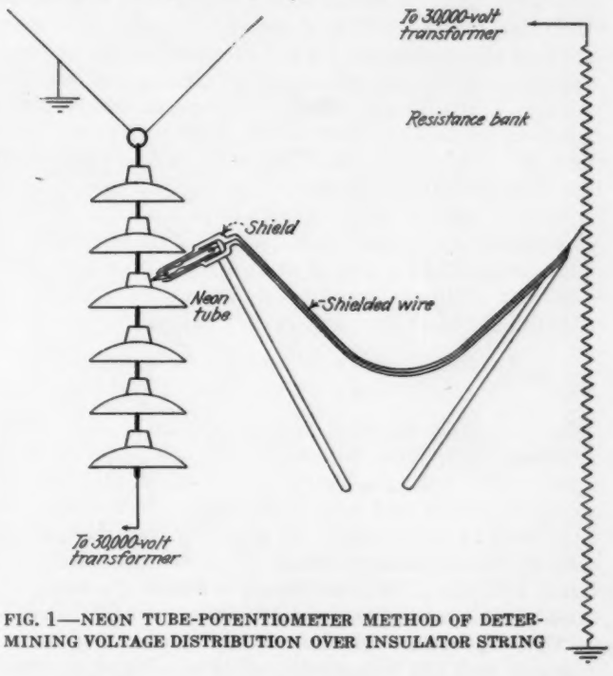


FIG. 1—NEON TUBE-POTENTIOMETER METHOD OF DETERMINING VOLTAGE DISTRIBUTION OVER INSULATOR STRING

small resistance units placed in series and attached to a large wooden frame as shown. (Fig. 7.) At rated voltage (110 volts) each unit draws approximately 0.5 amp., the average resistance being 273 ohms. Two such banks of 225 units each were available. With 30,000 volts impressed and about 0.5 ampere flowing, the leakage current from the bank to ground due to the capacitances of the units to ground is negligible.

The indicating device used in making most of these measurements was a Westinghouse "Spark C" neon tube. This was mounted on the end of a stick as shown. (Fig. 1.) The part of the rubber cylinder surrounding the inclosed electrode was covered with tinfoil, and a flexible wire tied to this tinfoil was connected

*Based upon a thesis by the author for a master's degree at the Massachusetts Institute of Technology with the co-operation of the high-voltage laboratory of the standardizing and testing department of the Edison Electric Illuminating Company of Boston.

to a brass probe on the end of another stick. A layer of insulation was placed over this tinfoil, and the whole tube and flexible wire were shielded with more tinfoil, the shield being tied to the brass tip of the probe stick. After several measurements were made it was found that it was unnecessary to shield the flexible wire, so the shield and wire were tied together just back of the neon tube. In either case the wire and shield on the tube are always at the same potential as the point of contact on the resistance bank, and any voltage across the tube must be due to a difference of potential between the point under measurement and the step on the potentiometer. While a capacitance exists between the shield and the link on the insulator string under measurement, when a condition of balance is obtained the link and the shield are at the same potential and no current flows between them. There will therefore be no disturbance in the insulator currents due to the shield. The effect of the capacitance between the shield and ground is not important, since any current flowing between them must be negligible compared with the 0.5 amp. in the resistance bank, and consequently the conditions in the bank will not be disturbed appreciably. The details of this method of making measurements are illustrated.

When this device was tried out, it was found that as the balance point was approached for a given measurement, the tube would stop glowing and remain out while the probe stick was moved over seven or eight units on the resistance bank. In other words, the tube was not sensitive enough to permit picking out the exact balance point directly. The balance point was obtained, however, by interpolating between the units at which the tube stopped glowing. This is slightly inconvenient, but it has the advantages of permitting more rapid balancing and of making possible measurements on strings containing faulty units. While it is possible to obtain neon tubes which glow at a voltage as low as 100 volts, for ordinary measurements such a tube would undoubtedly blow up when far off balance.

MEASUREMENTS ON STRINGS CONTAINING DEFECTIVE UNITS

In a good insulator string the power factors of the different units are very low and are approximately equal. The voltages across the individual units are nearly in phase and each is nearly in phase with the total voltage impressed. In a partly deteriorated insulator the resistance drops to a comparatively low value, and since the capacitance remains the same, the ratio of resistance current to reactive current increases so that the phase of the voltage across the unit is changed and the magnitude of this voltage decreases considerably. While the correct magnitude of the voltage across the faulty insulator can be obtained in the resistance bank, the phase of the voltage in the resistance bank will not be the same as that of the insulator voltage.

The diagram (Fig. 2) shows the approximate vector relations of the current and voltages in an insulator string with a defective unit on the line end. The current, I, leads the voltages V_1, V_2, V_3 and V_4 across the good units by nearly 90 deg., since in these units it is capacitative current. Since the resistance in the defective unit is comparatively low, the current becomes practically resistance current in this unit and is nearly in phase with the voltage V_5 across the unit.

If the exact magnitude and phase of the voltage

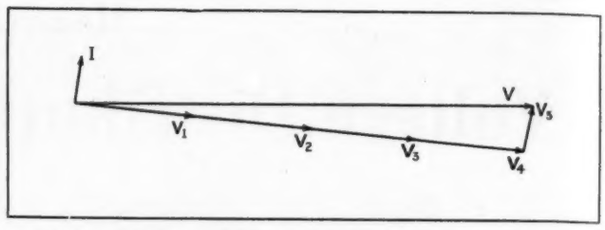


FIG. 2—VECTOR CURRENT AND VOLTAGE RELATIONS WITH DEFECTIVE UNIT ON LINE END OF STRING

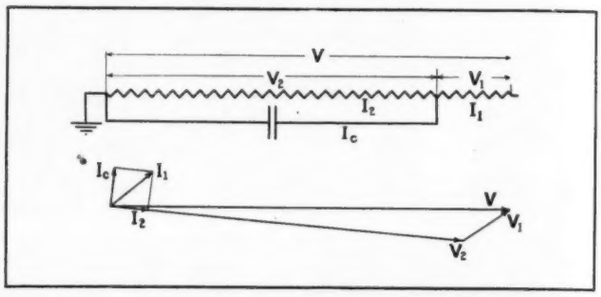


FIG. 3—VECTOR RELATIONS WITH CAPACITANCE METHOD, DEFECTIVE UNIT ON LINE END

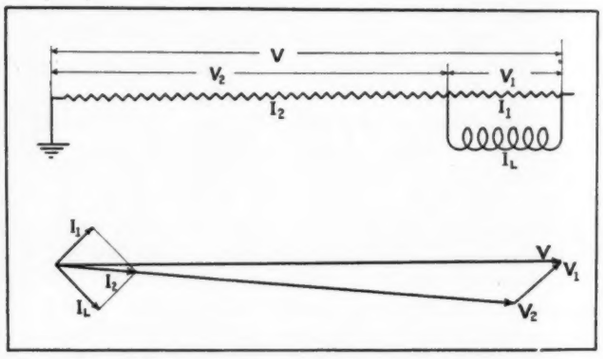


FIG. 4—VECTOR RELATIONS USING INDUCTANCE METHOD, DEFECTIVE UNIT ON LINE END

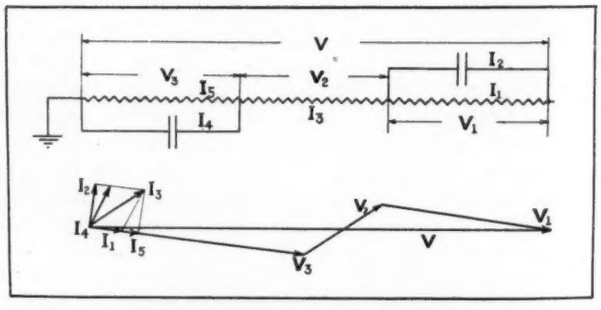


FIG. 5—VECTOR RELATIONS WITH CAPACITANCE METHOD, DEFECTIVE UNIT IN MIDDLE OF STRING

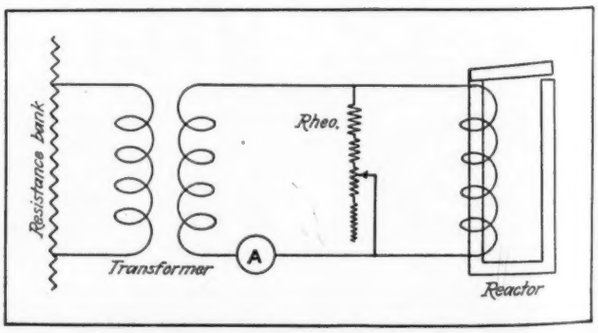


FIG. 6—APPARATUS FOR CHANGING POWER FACTOR

across the defective unit are desired, a different method of measurement must be devised. There are two possibilities whereby the correct conditions may be obtained. One method is to place a capacitance across the part of the resistance bank corresponding to the good units.

This method is illustrated in another diagram (Fig. 3). The vector diagram shows that the capacitances shift the vectors in the right direction and the proper size of capacitance will result in an exact reproduction of the conditions in the insulator string as far as voltages are concerned, and a balance can be obtained. The same results can be obtained by placing an inductance across the part of the resistance bank corresponding with the bad unit in the insulator string. A diagram (Fig. 4) illustrates the reproduced condition using the inductance.

USE OF CAPACITANCE AND REACTANCE METHODS

Since a high-voltage capacitance bank was available, the capacitance method was tried first. Considerable difficulty was experienced due to harmonics in the voltage impressed on the condenser and resistance bank. With harmonics present, it is impossible to obtain a balance due to the fact that the position of balance for the harmonic is different from that of the fundamental so that there is always some voltage across the neon tube. Although a harmonic of small magnitude is negligible in the impressed voltage, the magnitude of it is greatly increased in the condenser current, so that the current in the unbridged part of the resistance would have a large harmonic component. The voltage across this resistance would then contain the increased harmonic component that would be impressed across the neon tube. The harmonics were decreased to a minimum by operating a 60,000-volt transformer at half excitation, and a fairly good measurement of voltage distribution was made on the five unit string with the faulty unit on the line end. The results of this measurement will be given below.

An attempt was next made to measure the voltage distribution with the faulty unit in the middle of the string. Under these conditions a vector analysis shows that in order to get a balance the capacitance must be divided into two parts, one part being placed in parallel with resistance on the ground end and the other in parallel with resistance on the live end, a number of units corresponding with the defective unit being left unbridged in the middle. A diagram (Fig. 5) shows how this arrangement reproduced the insulator conditions. This adds two more variables to the number present in the last measurement—namely, the number of units of capacitance on the line end and the number of units with which it is placed in parallel. No success was met with in this measurement, and the idea was abandoned as being too complicated to be practicable.

Another possible method of arriving at a balance under the conditions as mentioned above is the use of a reactance in parallel with the resistance units corresponding to the faulty unit. An investigation was made as to the necessary dimensions of such a reactance. The above measurement showed that the defective insulator assumed between 1,000 and 2,000 volts. Rather than construct a reactance for 2,000 volts, a 2-kva. line transformer with a voltage ratio of 2,300 to 110 was used and a reactance was placed across the low-tension terminals. This reactance consisted of a 110-volt winding on a closed core transformer. One corner of the core could be opened by means of a thumbscrew so that a variable air gap was introduced. Although this arrangement gave almost any lagging power factor desired, the current could not be controlled, so it was necessary to put a variable resistance in parallel with the reactance. This outfit then made it possible to get any power factor at a constant current in the 2,300-volt side of the transformer. A diagram (Fig. 6) of this power factor changing apparatus is shown.

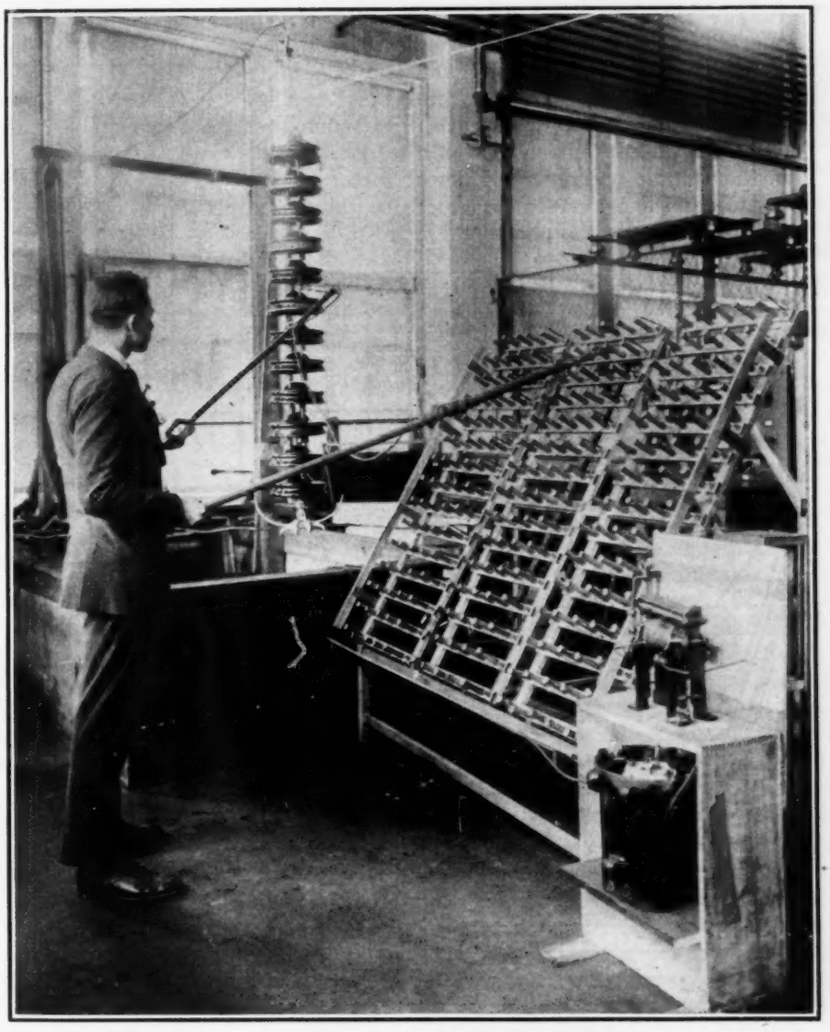


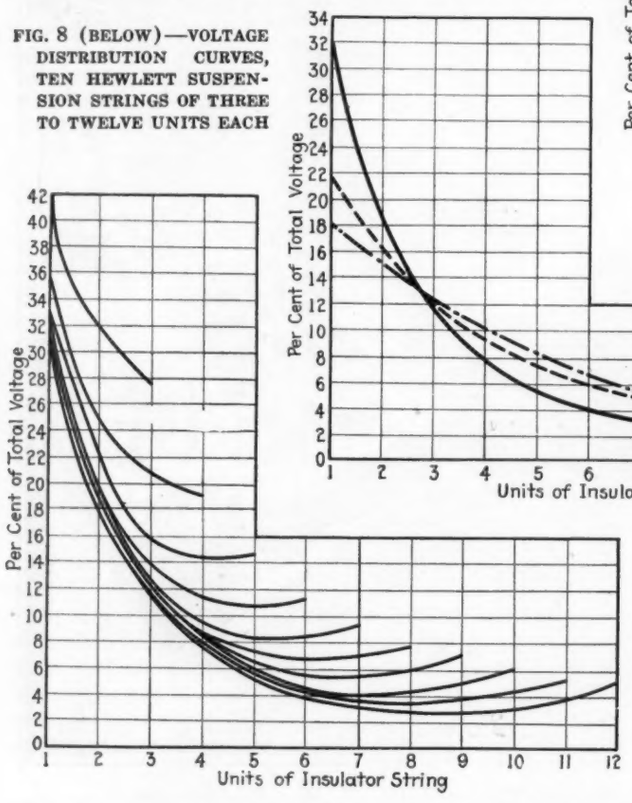
FIG. 7—TESTING POTENTIAL DISTRIBUTION OF INSULATOR STRING

The method of procedure for determining the voltage distribution with this apparatus is to go over the string first without any reactance in parallel with the resistance bank. A general idea of where the points of balance are for each side of the bad unit can be arrived

at in this way. The reactance is then tied in at these points, and by varying the reactance and resistance a balance may be obtained. Usually, however, the number of units across the transformer as well as the relative position of the transformer on the resistance must be varied also. An ammeter placed in series with the 110-volt reactance and resistance gives an indication of conditions so that they can be duplicated.

After a good balance is obtained for every link in the insulator string the power factor changing apparatus is disconnected from the resistance bank and such a voltage impressed on the terminals of the transformer as to give the same current in the ammeter that was observed before. Of course, the resistance and the air gap of the reactance must not be changed. A wattmeter, voltmeter and ammeter placed in the high-tension side of the transformer give the voltage, current and power factor on the high side of the transformer, and these values can be used to compute the phase and magnitude of the voltages across the individual units of the insulator string. A potential transformer is used to supply the potential for the wattmeter and voltmeter.

FIG. 8 (BELOW)—VOLTAGE DISTRIBUTION CURVES, TEN HEWLETT SUSPENSION STRINGS OF THREE TO TWELVE UNITS EACH



In order to determine how the distribution of voltage on suspension units changes as units are added to a string, measurements were made on strings of from three to twelve 10-in. Hewlett suspension insulators. The strings were hung from two steel wires attached to the ceiling and grounded. A string of three units was first hung up, equipped with arcing horns and having a piece of transmission line conductor attached to the bottom of the string so as to reproduce line conditions as nearly as possible. (Fig. 8.) After the distribution measurements were made on this string, another unit was added and a measurement made on the four-unit string. Units were added one by one up to twelve units, and after a measurement was made on the twelve-unit string a shield ring made from a tire rim 23 in. in diameter was placed on the bottom of the string below the bottom insulator unit. A measurement was made under these conditions, then the ring was raised so that it was around the bottom unit and another distribution measurement made. The results of these measurements are shown in the curves. (Fig. 9.)

All of these measurements were made with a total voltage of 25,000 impressed on the string and resistance bank. In order to determine whether or not the results would be any different if made at a higher voltage, two resistance banks were used and the voltage was raised to 55,000. The measurement was made on the twelve-unit string with the shield ring in the second position. Although the individual voltages differ slightly, the points were plotted on the curve sheet and a curve drawn through the points coincided almost exactly with the curve for the same string with 25,000 volts impressed. This test proved that the distribution does not change appreciably with a change of voltage—that is, within reasonable limits. If the voltage is increased up to a point where excessive corona would form, the corona would probably change the distribution.

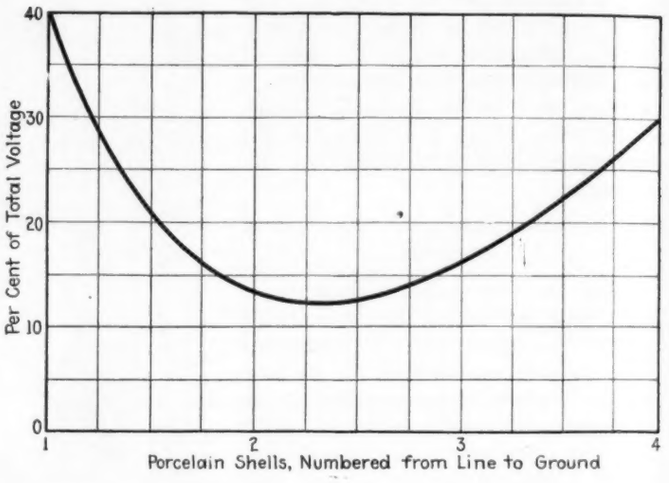


FIG. 10 — VOLTAGE DISTRIBUTION CURVE, 66-KV. PIN-TYPE INSULATOR

FIG. 9—VOLTAGE DISTRIBUTION CURVES, STRING OF TWELVE 10-IN. HEWLETT SUSPENSION UNITS

Full line represents unshielded string; dashed line, shield ring below string; dash-dot line, shield ring around bottom disk.

Curves (Fig. 9) show that for an unshielded string of more than five units the unit on the line end assumes approximately a third of the total voltage. For the three-unit and four-unit strings, the line units take somewhat more than a third, and curves for these strings do not turn upward on the ground end. In strings of five or more units, the ground unit takes slightly more voltage than the next one to it, and as the number of units increases from five to twelve, the unit taking the least voltage moves back from a position second from the end in the five-unit string to fourth from the end in the twelve-unit string.

The curves (Fig. 9) show the remarkable improvement of conditions when a shield ring is used, and also show that a change in the position of the shield ring changes the distribution considerably. This method of

measurement of distribution is very convenient as an aid in the design of a shield ring and for determining the best position for the ring.

The same voltage distribution outfit was used for pin-type insulators except that the point of contact of the neon tube was extended by means of a piece of copper about 2 in. long so that the cement between the lower petticoats could be reached. At this stage also it was found that the shield of the wire running to the probe stick for the resistance bank could be eliminated, the shield for the tube being tied to the wire just back of the neon tube.

This outfit worked very successfully. The voltage distribution was determined on a 66,000-volt pin insulator and the results of this measurement are shown in a curve. (Fig. 10.)

CONCLUSION

This method of making voltage distribution measurements is accurate enough for all practical purposes. It has the disadvantage of requiring the use of bulky apparatus and therefore is strictly a laboratory method. Much care must be used in its operation, since the wire between the two sticks is always alive at a considerable voltage above ground.

Restoration of Service

Intimate Contact with Men and Conditions on Adjacent Properties Facilitated the Securing of Replacement Equipment

IN THE FALL of 1926 a series of transformer failures at the generating station end of a transmission line serving two distant municipalities, several industrial plants and numerous residential customers caused an interruption of energy supply that threatened serious losses and inconvenience to the users of this service. The line was operated by a power company under centralized management from a headquarters city in the same state, and the restoration of service that followed was the direct result of two factors: first, the devoted personal work of the local utility organization, and second, the co-operation and driving power of the sales and engineering departments at headquarters.

The initial trouble occurred about 2 p.m. on Monday, Dec. 6, and this was cared for locally; but at 10 p.m. a transformer at the generating station end of the transmission line burned out and was cut free. The remaining two transformers of the set were run through the night on open delta, and at 11 a.m., Tuesday, a second transformer failed. The only recourse was to supply the two municipalities with single-phase service, and high-pressure work by the local company's linemen resulted in every house in the district served by this line being properly connected by evening.

Following the apparent emergency control of trouble on Monday, the manager of the local company went to a near-by city on Tuesday on other business, and during his absence report of the second transformer's failure was telephoned to the management company's office, where the power sales department immediately went into action to secure transformers for temporary service on the transmission line. The holding company engineer at the head of this department kept a log of his activities in this connection. Important mill service was interrupted, and the need of restoring the supply of energy to all customers with reduced power or cut-off power was most urgent.

The value of holding company management was brought out in this case by the procedure followed. Space will not allow reproduction of the log record, but the headquarters staff's intimate contact with conditions on other properties under this management and broad acquaintance with authoritative men in other utilities in the geographic region concerned were of the greatest aid in obtaining the necessary transformer units to replace those that had failed. Attention was concentrated on replacing the burned-out transformers, and in doing this the power sales department literally swept the state telephonically and in co-operation with the headquarters engineering department got in rapid touch with many leading companies within a 100-mile radius of the trouble. In this work membership in a power sales engineers' group that is also identified with the divisional section of the N.E.L.A. was of immense value, as the personal contacts that had been built up over years of meetings made the transaction of the business in hand a matter of minutes and seconds between engineers long on a first-name basis. By 5:01 p.m., Monday, 1,900 kva. in transformers was found available for transportation to the scene of trouble, and by 5:20 p.m., 600 kva. more was clinched and orders were given for disconnection and removal.

On Wednesday the headquarters power sales staff was busy cleaning up details, notifying customers of the efforts being made to restore service and looking up single-phase apparatus for the use of a woolen mill served by the transmission line. The local utility organization, meanwhile, with the aid of men from the headquarters engineering department, removed two of the burned-out transformers from the existing crib, set five poles on which to build necessary structures to hold wires, cable, etc., under clear but bitterly cold weather conditions. On Wednesday evening three 333-kva. transformers arrived at the local plant and were put in operation about 8 o'clock on Thursday morning. The next bank, three 200-kva. units, arrived Thursday morning and were placed in service later in the day, and the third bank of three 300-kva. transformers arrived Thursday noon and were in operation about 1 a.m., Friday. This re-established complete service. On Thursday the power sales department at headquarters checked up available power and notified customers as to the situation, and amid other activities traced transformers en route.

SPEEDY ACTION APPRECIATED BY PUBLIC

Customers stated in repeated cases their appreciation of the efforts being made in their behalf and of the continued all-night work of the utility company linemen and the activities of both local and headquarters staffs to clear up the situation. Team play was maintained throughout, and it is reasonable to state that without the co-operation rendered the shortage of power would have been greatly extended as to time. It is no reflection on the able and self-sacrificing service of the staff of the local company to state that the rounding up, transportation and installation of the necessary transformer banks of the proper characteristics would have been practically impossible in the time achieved by a small company not under centralized management. The resources of the headquarters organization were concentrated upon relieving and then curing the trouble, and its facilities and enthusiastic co-operation were genuinely appreciated by all concerned.

Letters from Our Readers

Experienced Reader Answers Questions of "A Young Engineer"

To the Editor of the ELECTRICAL WORLD:

I have read and reread several times the letter on page 168 of the issue of the ELECTRICAL WORLD for July 23 by "A Young Engineer" and have discussed it with my associates. While I am not an old, gray-haired reader and make no pretensions to being a "sage" or an authority on the questions the young man has asked, it has been my pleasure and experience to be connected with both public utilities and industrial plants in such a manner that some of these questions have been brought to my consideration long before this time, and the answers are pretty definitely established in my mind.

In answer to his first question, "Is research receiving the financial help it should receive?" there are three major places where research work is carried on, namely, industrial plants, schools and by private individuals. Heretofore there have been two classes of industrial plants doing research work. One class did only such work as was forced upon them in order to supply the demand of customers and by force of competition. The other class foresaw these demands ahead of their customers, leisurely did such research work as was necessary and offered their customers the resultant product before it was demanded. Examples of this kind of research are all around us, such as the high-pressure steam turbine, the automobile, radio, airplane, etc. Each of these products was developed and can be supplied much in excess of the present-day demand. Though there are imperfections in each, the research departments are gradually getting these out, are offering a better product at less money each year and are absorbing the cost of this work in their manufacturing costs. Therefore research work from the industrial-plant standpoint is comparable to advertising; they are both necessary and pay dividends and are being supported financially at present to an extent that more than meets the demands of the public.

The research work done by our colleges and universities is supported by either public, private or industrial endowments and cannot therefore be as extensive or remunerative as in the industrial research field. It is the writer's opinion that the research work done by the schools should be confined more to substances and theories than to the application of existing theory and practice, because industry has a means of knowing what is in demand and works to that end, while a school may do a great deal of expensive research work and find there is no present-day demand for such a product. If schools will confine themselves to the correct field of research work, their budgets will be supported.

Individual researchers will not be considered, as they are in the minority and are usually either self-supported or privately maintained.

To "Young Engineer's" second question, "Will the public utilities continue to draw the high-class help necessary fully and adequately to develop this greatest of American industries?" I answer: Yes, right along, because, as the questioner pointed out, "the central-station business is no more technical than any other business." Each industry draws its new blood from the schools each year, and the price paid is about the same per head to start. Gradually the new men receive more as they acquire experience and practical knowledge of the business. Whether it be energy production, dye manufacturing, railroading or electrical manufacturing, the average is about the same. As regards the banker or broker paying these young men any fabulous sums, let me inform "Young Engineer" that the salesmen or distributors of bonds must build up their clientage and produce results just as one is expected to do in any other industry.

In answer to the third question I will ask one. The kilowatt-hour is the standard unit of electrical measurement used throughout the world and is accepted by the public and by engineers alike, just as a gallon of paint or a pound of pork is accepted. Why try to introduce a number of new units, such as the standby charge, load factor, power factor, diversity factor or any other factor? It is hard enough to sell kilowatt-hours without springing all of these other items on the public and afterward having to explain their meaning. So far as the public is concerned, I say leave these qualifying factors alone and retain the kilowatt-hour as the basic unit. The packing houses sell their meat by the pound; oil companies distribute their product by the barrel. Each industry has its overhead expense, standby charges and whatnot, but it is glad to add these to the basic unit without further complicating the public's thinking apparatus. And the public is well satisfied with this plan.

J. H. WICKMAN.

Milwaukee, Wis.

Meaning of Vision, Sight and Television Still Basis of Discussion

To the Editor of the ELECTRICAL WORLD:

In regard to H. I. Mandolf's criticism on page 117 of the ELECTRICAL WORLD for July 16 of my objection to the present use of the word "television" in connection with the mechanisms for the extension of human sight, do not the blind possess vision and not sight? If a blind man possess vision and not sight, what, then, is vision? Words are always imperfect vehicles to convey thought. This will be so until such future time as we may develop through a long process of evolution the next great sense, that of thought transfer, which will be as much greater than sight as sight is greater than the other four. Thought transfer will be the physical, real expression of vision.

Always progress is made by first conceiving and then perceiving a thing through the senses. The inventor dreams and conceives of a thing and then by actual hard physical work he makes the dream or conception a physical reality. By the same process the lower forms of life struggle to reach a higher stage, which only becomes real as sense perception is developed. In the same way human beings struggle upward toward the light by the development of a greater sense perception.

Words are imperfect vehicles of thought and, irrespective of their derivations or minor differences, in the derivation of "tele" and "vision," let us realize that the word "vision" has been associated for a long time with, not eyesight, which is a mechanical, electrical, chemical action, but with that higher state of man, to lose which is to travel back toward the status of the animal!

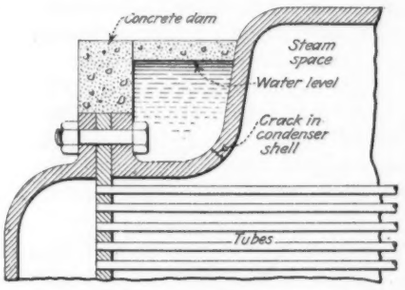
Mattapan, Mass. C. L. KASSON.

Central Station and Industrial Practice

Cracked Condenser Serves After Temporary Repair

BY E. H. KIRCHNER
Chief Engineer Winona (Minn.) Plant, Mississippi Valley Power Company

AFTER a period of satisfactory operation of the 5,000-kw. turbo-generator unit in the Winona plant of the Mississippi Valley Power Company there began to be experienced all at once some difficulty in maintaining vacuum in the condenser. After considerable time spent in hunting for the cause of this condition the trouble was finally located in a small crack at the top of



EMERGENCY CONDENSER REPAIR TO KEEP UNIT IN OPERATION

the back end of the condenser. The conformation of the condenser and location of the crack are shown in the accompanying sectional sketch. When the machine was put into operation and the condenser became warmed up, the shell expanded and caused the crack to open sufficiently to cause trouble. As this was the only generator in the power house and although the steam plant operated only to take the peak of the load on the system while a series of hydraulic plants carried the base load, it was not immediately convenient or even practicable to take the machine out of service while the end of the condenser shell was removed for repairs. In order then to correct the leaky condition in the least possible time a concrete dam about a foot high was built up on the flange joint of the condenser shell and end plate. The ends of this dam were turned to meet the down curve of the top of the condenser shell, thus forming a pocket open at the top and surrounding the crack in the shell. This pocket is kept filled with cold water, the supply of which is controlled by a float valve. The water draws off the heat from that part of the shell in which the crack is located, thus preventing the opening of the crack by expansion of the metal.

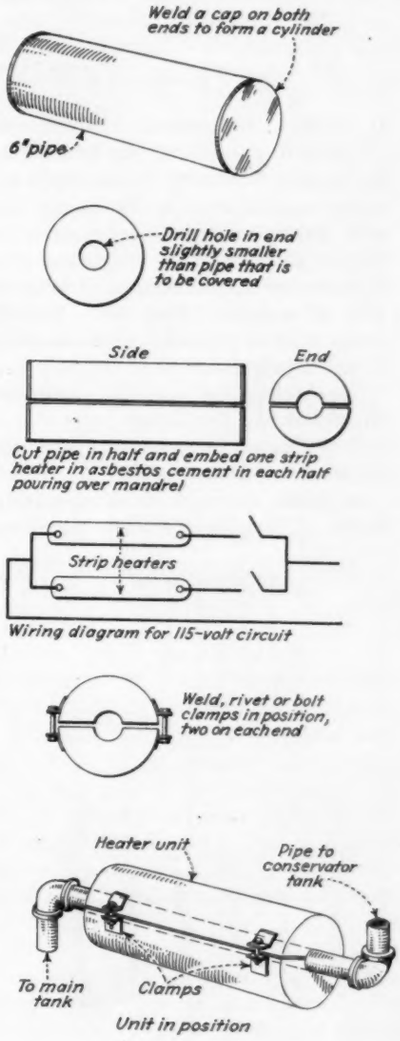
Warming Conservator Pipes on Transformers

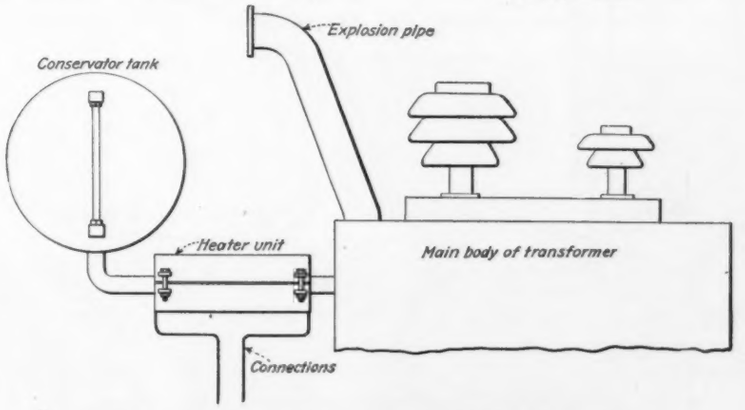
BY E. J. MORRISSEY
Chief Electrician Western United Gas & Electric Company, Aurora, Ill.

OIL conservator-equipped transformers operating intermittently during cold weather sometimes give trouble which can be traced directly to congealed oil in the conservator pipe. During the period in which the transformer is out of service the oil cools in the whole system, but particularly in the pipe to the conservator. On account of its exposure the oil may attain the viscosity of heavy grease. When the transformer goes back into service, the oil in the main body heats up fairly rapidly and its free circulation to the conservator tank may be so impeded as to raise the pressure in the main tank considerably. There being no breathers in this tank, the increase in pressure may manifest itself in appreciable leakage at the cover gaskets.

An effective way to thaw out the oil in the conservator pipe has been used employing chromolux or other strip heaters incased in ordinary asbestos pipe covering for heat retention. This expedient will do in an emergency, but for a permanent installation something better can be devised.

The device is made with a piece of 6-in. pipe, or larger if necessary, cut to a length determined by straight run of the conservator pipe. Caps are welded on each end of the 6-in. pipe and through them are


Weld a cap on both ends to form a cylinder
6" pipe
Drill hole in end slightly smaller than pipe that is to be covered
Side
End
Cut pipe in half and embed one strip heater in asbestos cement in each half pouring over mandrel
Strip heaters
Wiring diagram for 115-volt circuit
Weld, rivet or bolt clamps in position, two on each end
Heater unit
Pipe to conservator tank
To main tank
Clamps
Unit in position



ELECTRIC HEATER ATTACHED TO CONSERVATOR PIPE HEATER AND METHOD OF ATTACHMENT

bored holes slightly smaller than the outside diameter of the conservator pipe. The cylinder is then split lengthwise and a strip heater is embedded in asbestos cement in each half. Each half is equipped with ears by which the two may be clamped and drawn up tightly to the conservator pipe. The device may be connected so that one or both of the heating units may be used at the same time.

How Pacific Coast Utility Provides for Communication

BY H. S. LANE
Assistant to Engineer of Operation,
Pacific Gas & Electric Company, San Francisco, Cal.

SUCH a widespread transmission system as that of the Pacific Gas & Electric Company (covering a territory approximately 300 miles long and 150 miles wide) necessarily requires an extensive communication system for dispatching and transaction of company business. For the same reason reliable communication is extremely important.

The telephone system comprises the following facilities:

1. Privately owned and operated lines of two classes:

a. Lines carried on transmission leads. These lines are not permitted to be connected with the circuits of the telephone company.

b. Lines installed on routes separate from transmission lines. These lines may be and in a number of cases are used in conjunction with the leased lines and other facilities of the telephone company.

2. Bell system and other companies:

a. Leased circuits, including those between properties within exchange areas, transbay cable circuits and long-distance lines.

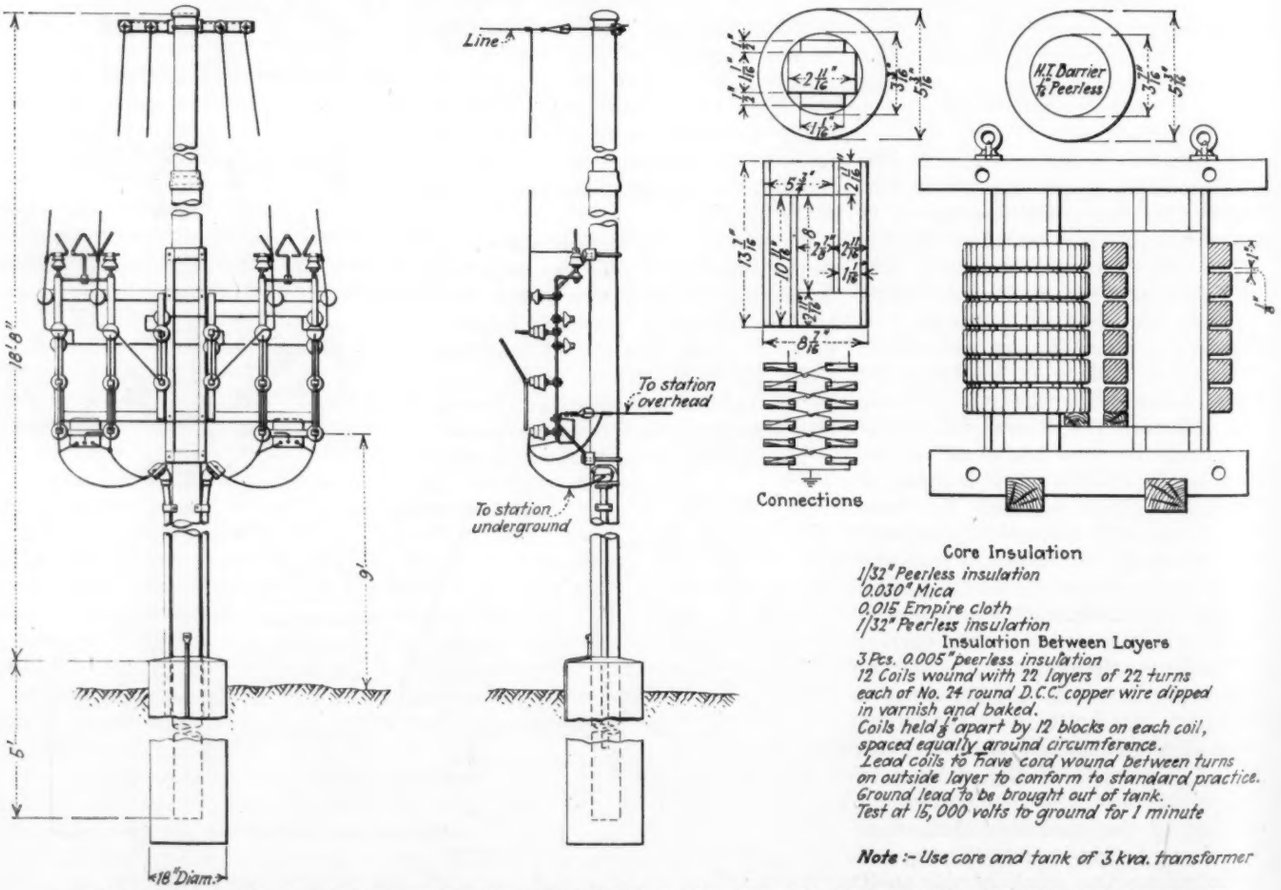
b. Subscribers' lines from central office.

c. Private-branch exchanges and intercommunicating systems.

3. Carrier-current telephone system.

The load dispatcher's office and main switching centers are served by private, leased and central-office circuits. At other stations there are usually two phones, one on either the private or leased lines and the other a central-office subscribers' line, except that a number of the power houses, on account of their remote location, have only the private line. From a strictly operating standpoint it would appear that the most satisfactory results are obtained from privately owned lines built in accordance with modern telephone practice as to construction of lines and use of instruments and protective devices, supplemented by connection to the Bell system for use in emergencies. This is particularly apparent when severe weather conditions cause general disruption of both transmission and communication systems, inasmuch as under such conditions the telephone company is required by state regulations to give preference to demands of the general public.

The extent and character of the


18'-0"
9'
5'
18" Diam.
Line
To station overhead
To station underground
H.T. Barrier
Connections
Core Insulation
1/32" Peerless insulation
.030" Mica
0.015 Empire cloth
1/32" Peerless insulation
Insulation Between Layers
3 Pcs. 0.005" peerless insulation
12 Coils wound with 22 layers of 22 turns each of No. 24 round D.C.C. copper wire dipped in varnish and baked.
Coils held 1/8" apart by 12 blocks on each coil, spaced equally around circumference.
Lead coils to have cord wound between turns on outside layer to conform to standard practice.
Ground lead to be brought out of tank.
Test at 15,000 volts to ground for 1 minute
Note :- Use core and tank of 3 kva. transformer

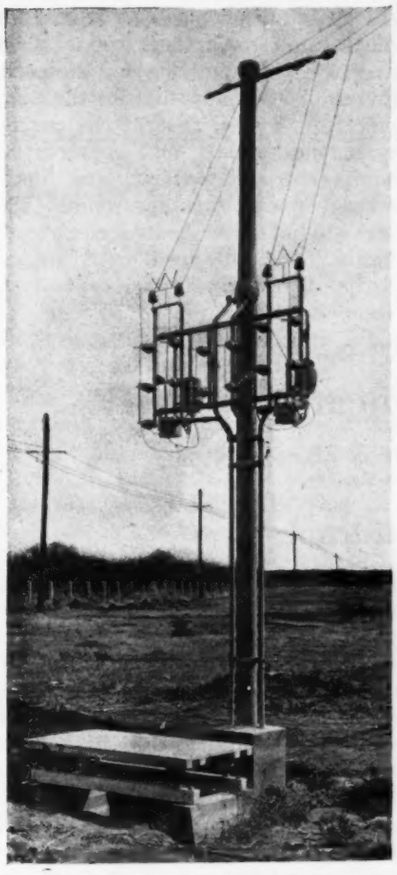
DETAILS OF STANDARD TELEPHONE PROTECTION AND ASSEMBLY OF TELEPHONE DRAINAGE COIL HAVING LOW DISTRIBUTED CAPACITY AND GOOD INDUCTANCE AND CAPACITY BALANCE

company's private telephone facilities above noted are:

Private lines:	Miles
Overhead circuits, two-wire....	2,971
Overhead circuits, one-wire and ground return	268
Total.....	3,239
Underground and submarine cable, one to ten pair	7.8

The single-wire circuits are all along flumes or ditches or like places of lesser importance, mostly in mountainous territory. The older practice was to build power line telephone circuits of iron wire, usually No. 9. Present tendency on all lines of any considerable length and importance is to use hard-drawn bare copper, usually No. 8. All lines are magneto lines using standard Western Electric or Kellogg phones with five-bar generators, 2,500-ohm ringers (or relays), with code ringing. Transpositions are made with due regard to location of power line transpositions and length of exposures in accordance with standard schemes adopted from the practice of the Bell system, except that on many of the "hot" lines, particularly the older single-circuit lines, transpositions are made at approximately half-mile intervals with a transposition at each power line transposition.

Protective equipment at telephone stations on all lines subject to hazard from power lines consists of a combined horn-gap switch and fuse, vacuum and air-gap arrester and insulating transformer (the latter only where insulating stands are not used). The horn-gap switch and fuse, as well as instrument panels and switchboards, have been developed by the Pacific Gas & Electric Company and are built in its shops. Where no hazard from power lines exists, standard station protectors are installed. On certain lines where



STANDARD TELEPHONE PROTECTION USED BY PACIFIC GAS & ELECTRIC COMPANY

trouble was experienced on account of static and induced voltages, drainage coils, designed and built by the company, have been installed and have effectively relieved the difficulty. In this coil distributed capacity is minimized and the balance of capacity and inductance is exceptional.

For the past three years the company has had in service three carrier current telephone installations, each comprising one 50-watt speech amplifier tube, two 250-watt modulator tubes and two 250-watt oscillators in the sending circuits. The receiving circuits consist of a Kennedy type 110 Universal receiver, Western Electric No. 7-A power amplifier and loud speaker. The two chief difficulties that have been encountered in the operation of these sets are interference from other transmitters, both carrier and space radio, and the effect on the constants of the antenna circuits from switching on the transmission system, requiring in some cases that lines be returned to service before communication can be re-established. Because of these difficulties the company has had on installation and trial equipment from three manufacturers designed to provide duplex talking, interphase coupling and selective signaling. The tests made on the company's 220-kv. Pit River lines have been completed, but the outcome has not been made public and no equipment has been purchased yet.

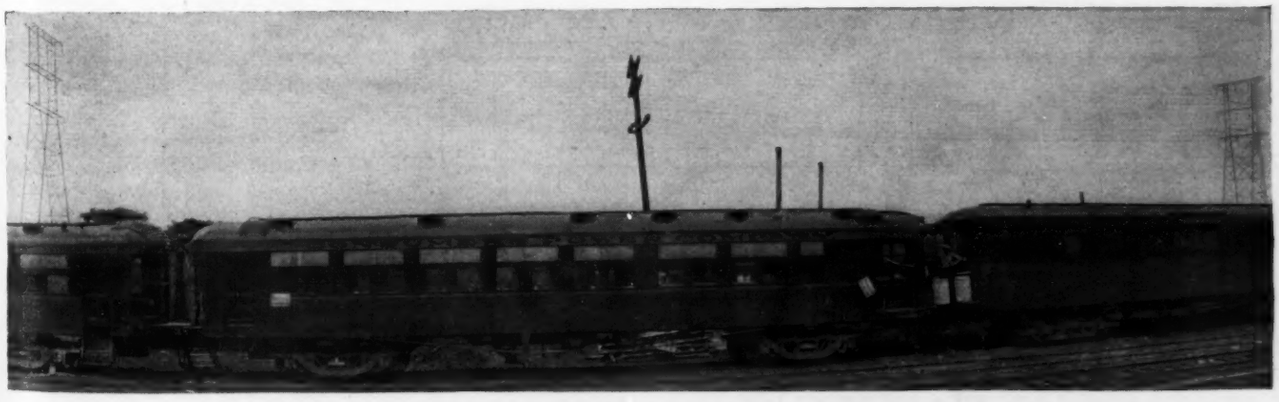
No attempt has ever been made by the company to use space radio telegraph. It is too slow for dispatching, particularly in emergencies, and involves the use of trained telegraph operators at all locations where radio apparatus is installed.

Construction Camp on Wheels

BY H. H. TINKHAM

Consumers Power Company, Jackson, Mich.

TO AVOID the expense and delay connected with erecting and tearing down of temporary construction shacks housing the crews used in transmission-line construction, the Consumers Power Company has placed in service a string of five all-steel cars. The transmission lines of this company parallel either the steam or the electric railways of the southern part of Michigan, permitting ready use of a camp of this character. The dissolution of a local interurban railway company per-



PARTIAL VIEW OF FIVE-CAR CONSTRUCTION TRAIN OF CONSUMERS POWER COMPANY

mitted the acquisition of this rolling stock at a reasonable figure. Special arrangements with the steam and electric lines of the state permit the coupling of these cars to any regular train in event of emergency.

Two of the cars are sleepers with all-steel double-deck full-width beds. The dining car also contains the kitchen equipment and has tables which are hinged and may be clamped down to keep the car clear for assembly purposes at other than meal times. Another car is given over to living quarters for the cooks and their assistants and for the camp officers. A steel freight car carries emergency repair and construction equipment and material and has a storage space for camp supplies. The cars are hot-water-heated, electrically lighted and equipped with shower baths. The train has the capacity to accommodate a crew of 50 men.

Rural Line Specifications—XIII

Of the Wisconsin Power & Light Company

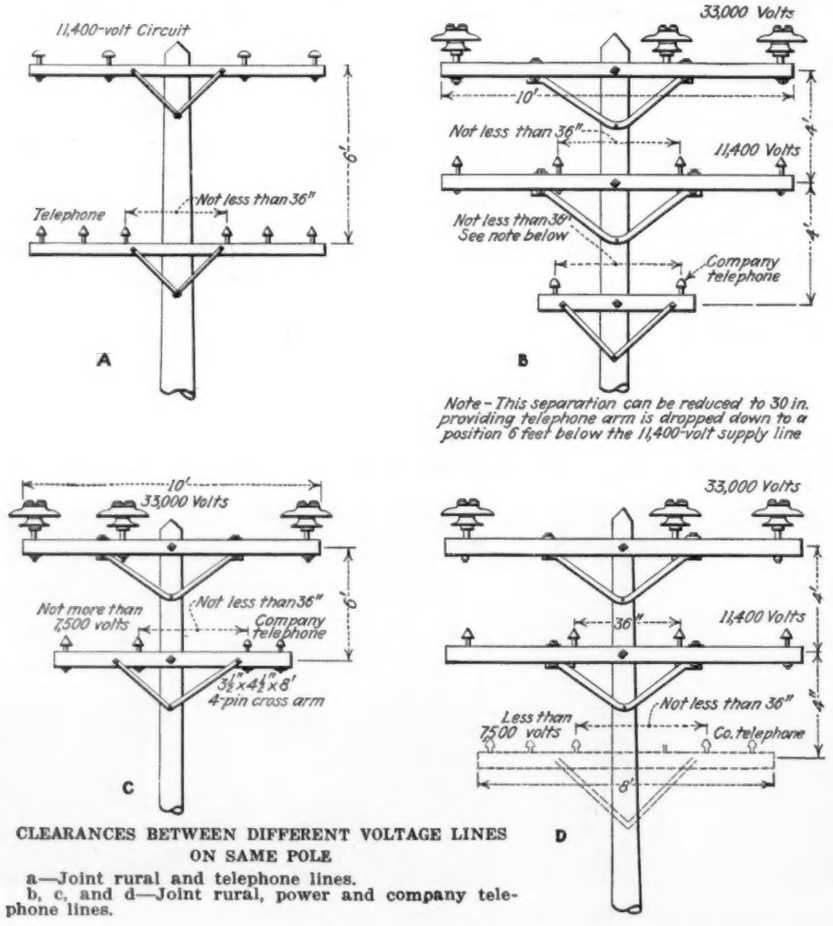
Joint Construction

CLEARANCES necessary between 33,000-volt, 11,400-volt and company telephone circuits placed on separate arms are indicated in the accompanying illustrations. Note that the climbing space required on the 11,400-volt Y circuit is not less than 36 in. If this distance is less, it will be necessary to de-energize this circuit before climbing through in order to make repairs to the 33,000-volt circuit. This requires the use of a 3¾-in. x 4¾-in. x 10-ft., four-pin arm or the standard four-pin, 33,000-volt arm. If the distance between the rural line arm and the company telephone arm is 4 ft. or more and less than 6 ft., it is necessary to use a standard 3½-in. x 4½-in. x 5-ft. 7-in., four-pin arm, leaving the pole pins vacant, as a clear space of not less than 36 in. is required. If the vertical separation between the two lower arms is 6 ft. or more, the conductor separation on the telephone arm may be reduced to 30 in., in which case the standard 3-ft. 2-in., two-pin arm can be used.

The drawing also illustrates a 33,000-volt circuit and single-phase rural circuit and company telephone on the same pole using one arm for the latter two circuits. Note that the vertical clearance must be 6 ft. and the clearance between the rural line and telephone line must be not less than 36 in. In order to avoid any errors in identifying the circuits on the same arm, the word "tel" and voltage "6600" should be stenciled on the arm below the respective circuits.

The drawing at "b" illustrates the same conditions as at "d" except that in dotted lines have been included a third arm carrying a circuit of less than 7,500 volts (6,600-volt, delta, three-phase, three-wire, 2,300 or 4,000 volts, or two wires—neutral and phase wire of an 11,400-volt, three-phase, four-wire line) and a company telephone line. The drawing at "a" illustrates joint rural and telephone circuits.

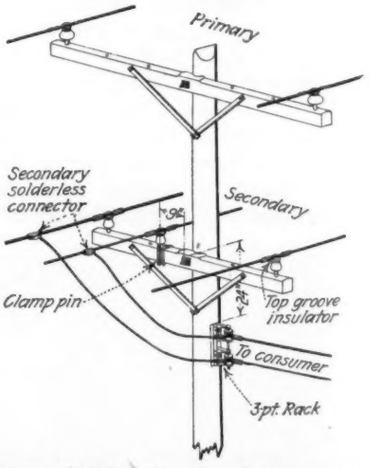
If it is possible to get more than 7,500 volts between wires, the company telephone line cannot be placed on the same arm. In other words, two wires and a neutral of an 11,400-volt Y system cannot be placed on the same arm with a telephone, as there are two wires carrying more than 7,500 volts.



CLEARANCES BETWEEN DIFFERENT VOLTAGE LINES ON SAME POLE

a—Joint rural and telephone lines.
b, c, and d—Joint rural, power and company telephone lines.

Rural Service-Line Connections



ON PAGE 968 of the May 7, 1927, issue of the ELECTRICAL WORLD are shown the single-phase rural transformer installation specifications of the West Penn Power Company. The method of making consumers' service-line connections is not shown in these specifications, and this is therefore presented in the accompanying illustration.

Commercial Activities and Public Relations

Organization of a Complaint-Handling Department

By George I. MacKenzie

EVERY operating utility company has found or will find that one of its greatest assets is the good will of the people whom it serves. To obtain and maintain this asset an operating company must fulfill two requirements: (a) Supply service of the highest quality, and (b) show every reasonable consideration to a dissatisfied customer. If a customer enters a complaint of any nature, it is the duty of the company to investigate the merits of the reported irregularity, and if the customer had a justifiable reason to be dissatisfied, the company should make the necessary adjustments.

In order promptly and efficiently to attend to the customers' complaints it has been found necessary by operating companies to equip and maintain a special department to investigate conditions, correct faults and, most important of all, establish the good will of the complainant. This article outlines the organization of a complaint-handling department employed by an Eastern light and power utility and shows specifically the routine followed in handling radio complaints.

Four Departments Usually Involved

Before a complaint has been received, investigated and closed out four departments in addition to the complaint-handling department are sometimes involved. These four departments are: (a) commercial, (b) engineering, (c) special test and (d) construction. The commercial department is, in 85 per cent of the cases, the first to receive the customer's complaint. This is due to the fact that the customer is most familiar with the routine and personnel of the commercial department. Many of the complaints are entered when the customer pays the monthly bill, others are written, and in some cases the consumer telephones direct and demands immediate action. It is the duty of the commercial department to acquire all useful information and forward all the material to the engineering department.

The engineering department records all the pertinent facts relating to the complaint, then passes the information along to the complaint-handling department. In this department is a clerk who keeps all the records and information in a form that can be easily referred to. A very satisfactory procedure for the clerk to follow is to file each complaint alphabetically under the complainant's name and record all developments on a specially prepared form which shows at a glance the status of the job.

The complaint-handling personnel also includes one distribution engineer, one lineman authorized to perform high-tension testing or repair work, one man to install and take charge of graphic meters and all ordinary tests, one radio expert with an assistant to aid in tracing down sources of interference, one stenographer and one executive engineer in charge of the department. Transit facilities are supplied persons who do the field work; a small automobile truck is very convenient.

Engineering Department Aids in Special Work

In all ordinary cases the commercial department and the special department will completely handle the job, but when it is found upon investigation that extension work has to be done, such as running or replacing primary or secondary wire, hanging, removing or replacing transformers, cutting up or rerouting circuits, etc., the engineering department must authorize the new layout, and the actual work will be done by the construction department. During the progress of the work on a job that will be of more than a week's duration the commercial department keeps in touch with both the construction department and the customer and aids in promoting a satisfactory relationship, thereby speeding progress.

Procedure on Receipt of Complaints

When a customer complains of radio trouble believed to be caused by the operating utility, the commercial department may send to the complainant a questionnaire similar to the one shown. This serves a dual purpose: (1) It gives the radio testers and investigators valuable and helpful information, in many cases pointing out immediately the cause of the trouble and (2) it tends to reduce the number of minor or unjustifiable complaints.

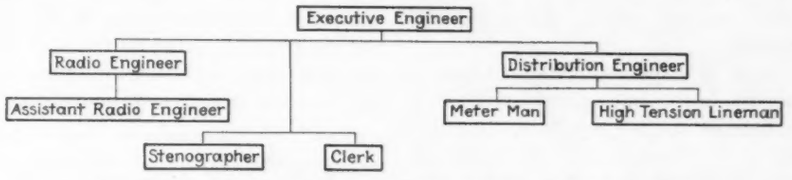


FIG. 1—PERSONNEL OF DEPARTMENT HANDLING COMPLAINTS

A complaint-handling department organized as illustrated can satisfactorily handle any type of complaint except a high bill or electrolysis trouble. High-bill complaints should be adjusted by the commercial department, and electrolysis trouble should be investigated by a special test department. All other complaints of a technical nature would fall under either the distribution engineer or the radio expert.

If unsatisfactory voltage is reported, the distribution engineer checks up the field conditions, and the meter man and the high-tension lineman perform all necessary tests. If extensive field work must be done, the distribution engineer draws plans and submits them to the engineering department for approval. All radio troubles are investigated by the radio expert and his assistant. If the trouble is traced to some defect on the high-tension equipment, such as arcing at a faulty splice, the lineman is

No. ..... *Feeder No.* .....
Name .....
Address .....
Telephone .....
Complains of .....
Complaint received on .....*from*.....
Date and time of investigation.....
Memoranda .....
Voltage test made.....*Indicating*.....*Graphic*.....
Maximum voltage (over considerable period).....
Minimum voltage (————————).....
Maximum voltage dip .....
Nature of radio trouble.....
Probable cause .....
Memoranda .....
Nature of work to be done.....
Work order issued on.....*Completed*.....
Retest completed on .....
Result of test .....
Complaint closed out on.....

FIG. 2—RECORD OF COMPLAINT AND ACTION TAKEN TO RECTIFY THE DIFFICULTY

Name..... *Date*.....
Address .....
Phone .....
1. *What type of set do you use?*.....
2. *No. of tubes?*.....*Type of tubes*.....
   If home made what circuit do you use?.....
3. *Type of aerial (loop, outdoor, etc.)?*.....
   If outdoor aerial in what direction is it running?.....
4. *Name, address and phone number of concern that said trouble was caused by*.....*Company*.....
5. *Do you use any battery eliminators?*.....
6. *Is the total energy derived from the lighting circuit?*....
7. *Is the interference a hum, buzz, squeal, hiss, tap, crackling, frying or roaring noise?*.....
8. *Is the noise continuous?*.....
9. *During what hours is this noise most severe?*.....
10. *Do you receive the interference at all settings of your dials?* .....
11. *What in your opinion is the cause of the interference?* .....
12. *When is there someone at home who can operate the set?* .....

FIG. 3—THE QUESTIONNAIRE SENT TO INTERFERENCE REPORTERS HELPS LOCATE CAUSE AND REDUCES MINOR COMPLAINTS

called out to aid in correcting the trouble.

It is of paramount importance to correct faults and satisfy customers as rapidly as is reasonably possible, and it has been found that a competent personnel in a department similar to the one outlined will prove very effective in cutting down unnecessary routine with its corresponding loss of time.

It is difficult to estimate the monetary value of a customer's good will, but in the case of an operating utility the friendly customer is well worth the few thousand dollars expended annually to maintain a department which more than anything else aids in promoting a unified atmosphere of justice and honest consideration.

Value of Commercial Refrigerating Load

DATA on the energy consumption and output of three electrically driven ice plants were presented recently before the joint meeting of the Interstate Power Club and the New England Association of Central-Station Power Engineers by E. L. Fleming of the Public Service Electric & Gas Company of New Jersey.

These plants are all of the raw-water type. Plant A (200 tons per day) is two years old, having been built for electrical operation, and may be considered modern in every respect. Its production was achieved on the basis of 40.7 kw.-hr. per ton, year's average, 1926. Plant B (150 tons per day) is an old steam-driven installation which was completely electrified about two years ago. New ammonia compressors were installed at the time. Plant C (80 tons per day) is two years old, with modern electric drive and up-to-date equipment throughout.

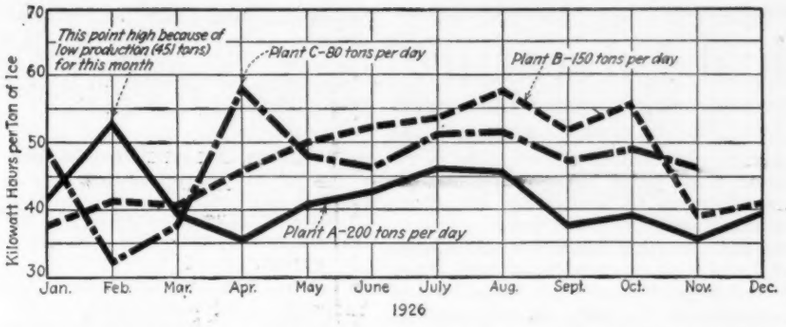
It will be seen that the energy consumption per ton of ice manufactured in Plants A, B and C was less during the winter months (except in February in Plant A, when production was curtailed) than in summer, even though production was lower during the winter. This is due to the water being colder in winter, which assists in two ways in lowering the energy consumption per unit of product: (1) The lower temperature cooling water in the condenser diminishes the head pressure in the ammonia compressor with a consequent reduced power input to drive the compressor; (2) as the initial temperature of the water in the ice cans is lower in the winter, the heat extraction which is required to make ice is less.

The energy consumptions from

TABLE I—OPERATING DATA ON THREE ELECTRICALLY OPERATED ICE-MAKING PLANTS

Plant	Capacity of Plant in Tons Per Day	Total Hp. of Motors in Plant	Approximate Total Cost of Electric Installation	Number and Size of Ammonia Compressors: No.	Type	Size, In.	Speed, R.P.M.	Hp. and Type of Motor	Average Kw.-Hr. Per Ton Over the Year
A	200	974	$30,000 ($31 per hp.)	3	Duplex single acting	10 x 10	180	75 Syn.	40.7
					Duplex single acting	14½ x 16½	180	225 Syn.	
					Duplex single acting	16 x 18	164	375 Syn.	
B	150	720	.....	3	Duplex single acting	10 x 10	180	75 Syn.	49.0
					Duplex single acting	11½ x 13½	180	100 Syn.	
					Duplex double acting	12½ x 24	90	375 Syn.	
C	80	392	$14,000 ($36 per hp.)	2	Duplex single acting	10 x 10	200	100 Syn.	49.0
					Duplex single acting	12½ x 14½	180	180 Syn.	

	Plant A 200 Tons			Plant B 150 Tons			Plant C 80 Tons		
	Tons of Ice	Kw.-Hr.	Kw.-Hr. Per Ton	Tons of Ice	Kw.-Hr.	Kw.-Hr. Per Ton	Tons of Ice	Kw.-Hr.	Kw.-Hr. Per Ton
January	1,094	43,800	40.1	1,832	68,800	37.6	725	36,000	49.6
February	451	2,394	53.2	1,422	58,800	41.5	197	6,240	31.7
March	1,516	59,820	39.5	1,978	80,000	40.5	672	25,440	37.9
April	3,101	108,900	35.2	2,139	97,600	45.7	854	49,680	58.1
May	4,585	185,760	40.5	3,762	188,000	50.0	1,032	49,680	48.1
June	4,769	202,500	42.5	3,811	199,200	52.2	1,477	68,160	46.2
July	5,759	265,620	46.0	4,419	236,400	53.5	2,203	112,320	51.0
August	5,433	245,880	45.3	4,114	237,600	57.6	2,350	121,200	51.5
September	3,704	138,420	37.4	3,890	200,800	51.4	1,585	74,880	47.3
October	2,523	99,180	39.3	3,176	177,200	55.8	1,083	53,280	49.1
November	2,601	92,040	35.4	2,092	81,600	39.1	695	32,160	46.2
December	1,437	56,640	39.5	1,810	74,000	40.9	.....	.....	....
Total	36,973	1,500,954	40.7 (Avg.)	34,745	1,700,000	49.0 (Avg.)	12,873	629,040	49.0 (Avg.)



MONTHLY VARIATIONS IN TOTAL PLANT ENERGY PER TON OF ICE MANUFACTURED

month to month in Plants A, B and C per ton of ice manufactured are plotted in the figure.

On this system (where there is about 26,000 connected horsepower in ice-making plants) synchronous motors are widely used on account of their power-factor corrective service, and there is a decided trend toward automatic starting on full line voltage. The single "bump" which this entails is by many engineers considered preferable to possible repeated attempts to start by hand operation with ensuing disturbances.

"Cutouts" and Radio Sell Electrical Home Idea

BELIEVING that the rising generation would respond quickly to a contest in equipping even a paper home electrically and so become future prospects for the broader use of electrical appliances, the Edison Electric Illuminating Company of Boston recently conducted a novel cutout campaign in which the facilities of its radio broadcasting station W E E I were utilized most effectively and more than 20,000 customers circularized. The material used in the campaign consisted of six cards representing a kitchen, dining room, living room, bedroom, bathroom and nursery, with locations designated on each for electrical appliances. A separate card containing appropriate electrical equipment for each room was provided, the appliances being numbered and tabbed for insertion in appropriate slots when cut out. Thirteen thousand cutouts of each room were sent to the mailing list of the Boston Edison "Big Brother Club" in the company's territory, and 7,000 additional cutouts of each room were distributed through the district offices of this utility. Seven hundred completed houses were sent in to the office of the club and many incomplete cutouts were received as an indication of the popular interest aroused.

The distribution of the cutouts was timed so that Big Brother Club members were able to assemble each room in conjunction with the regular weekly radio talks of "Big Brother" Bob Emery, who heads this branch of the company's activities and devotes his time to building up friendly relations with the many thousands of boys and girls who listen in to the club doings and participate in them.

The purpose of the electrically equipped playhouse, which was furnished by Madeco, Inc., New York, was to educate the child through the play idea, and the adult through the interest of the child, in the various domestic uses of electricity; to create good will and to increase the central-station load through an increased demand for appliances. Seven lectures were broadcast from W E E I during the winter, including an introductory talk on the advantages of electricity in the home and six talks discussing the use of the various appliances in the represented rooms. To maintain interest three grand prizes and 32 district prizes were awarded. The grand prizes were: (1) a Savage washing machine; (2) a Premier vacuum cleaner, and (3) an Ever Hot cooker. Electric lamps comprised the district prizes. Each person who turned in a set of six rooms completely equipped received a premium of one dollar to be applied against the price of an electrical appliance purchased from the company.

The company ran a window display of a finished house in its main offices at Boston, but district offices decided against putting the electrical playhouse in each window on the ground that the volume of requests for cutouts would become burdensome. The contest attracted great interest on the part of the public, grown-ups as well as children trying their hands at inserting the cutouts and other paper figures in the different rooms in original ways. It is impossible to determine the effect of the campaign from the company's appliance sales, but there is no question in the minds of the company officials that the contest assisted greatly in popularizing electrical appliances as home equipment throughout the company's territory and in many distant places reached by its broadcasting.

WINDOW DISPLAY OF COMPLETELY EQUIPPED HOME

This is typical of the six cutouts furnished to illustrate electrical applications in the home. Slots on the room layouts were numbered to identify the appropriate appliances for these locations. On the backs of these folders were listed various appliances, their price and the cost of operation per hour. In addition the addresses and telephone numbers of the various district offices of the company were listed.

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Power Station Efficiency in Britain.—HUGH QUIGLEY.—A comparison of the results achieved during the past four years in improving over-all thermal efficiency in British generating stations. The economic significance of the progress realized is indicated, while special attention is devoted to the advance made by the 25 most efficient stations, with a notation of the economies realized nationally through higher thermal efficiency. A rapid reduction of fuel consumption per kilowatt-hour has been effected in Britain, as shown by the decrease from 3.11 lb. in 1921 to 2.40 lb. in 1926. The average for the United States is given by the author as 2.10 lb. per kilowatt-hour. In twenty-five British stations the average over-all thermal efficiency has risen from 15.35 to 17.05 per cent. It is stated that if the entire country had been able to show an economy commensurate with that effected by these stations, the saving in cost of coal alone would have been equal to 11 per cent of the entire revenue derived from the sale of electricity and would have been sufficient to yield a high return on the capital invested in new generating plants.—*World Power (England)*, July, 1927.

Priming in Cross-Drum Water-Tube Boilers.—A. BEMENT.—The use of baffling in the drum of cross-drum water-tube boilers to prevent the discharge of water with the outgoing steam at high rates of evaporation is described by the author. A sudden and strong demand for steam on a boiler raises the water line and the liquid is carried over. The reason for this is that the reduction in pressure permits a rapid evaporation of steam, and as the volume of steam is greater than that of the water, there is an increase in the volume of the apparent liquid content. Velocity of the flowing steam plays an important role in causing priming. Experiments were undertaken with a number of different types of baffles installed in an experimental boiler, and conclusions regarding the type best suited for this purpose are given.—*Power*, July 12, 1927.

Transmission, Substations and Distribution

Insulating Oil.—A. R. EVEREST.—Largely because of sludge formation, insulating oil has been the subject of considerable investigation in Great Britain. The experiments of A. C. Michie have shown that when transformer oils are heated for prolonged periods in contact with air or oxygen, the solid matter separates in varying quantities, depending upon the quality of the oil, the temperature and the duration of heating, and that these deposits are the result of oxidation of the oil by atmospheric oxygen and subsequent polymerization. The desirability of using an oil of low viscosity and the fact that reduced viscosity can only be obtained at the expense of reduced flash point are pointed out. In transformers in which the oil circulates without the influence of mechanical aids to circulation, the circulation of the oil and the amount of heat transferred depend on the difference in density between the hot and cold portions of the oil. The maintenance of this circulation depends upon the cooling of the oil before it re-enters the coils. The viscosity of the oil at a lower temperature has a considerable influence upon the amount of circulation, for if the oil has a high viscosity when cooled, the necessary free circulation cannot take place. British specifications employ the closed flashpoint, which in general occurs at a temperature 10 deg. to 15 deg. C. lower than the open flashpoint. Dielectric strength is determined by the use of spherical electrodes. Non-inflammable insulating fluids have not been fully investigated.—*Journal of Institution of Electrical Engineers (England)*, July, 1927.

Care and Adjustment of Voltage Regulators.—WILLIAM H. TURNER.—The maintenance problems encountered in connection with the operation of voltage regulators and the methods of securing the proper functioning of relays for this class of apparatus are considered in connection with the difficulties arising for several different types.—*Power*, Aug. 9, 1927.

A South Wales Power Transmission Scheme.—A short 33,000-volt interconnection has been placed in operation in Wales and has proved of great interest as it represents in miniature many of the factors incorporated in the national scheme for linking generating stations according to the plan contemplated by the electricity commissioners of Britain. The transmission towers are composed of galvanized-steel angle irons and plates, and all the joints are secured by means of bolts. The novelty in the design of the towers in so far as regards British practice lies in the fact that they are semi-flexible as opposed to the rigid structures commonly adopted for similar work. The usual standards of construction require that towers possess a sufficient reserve of strength to accommodate without flexure the stress which would be thrown upon them if one or more of the transmission cables broke. These towers are designed to deflect under a broken wire load. Should one or more of the cables break, the unbalanced pull of the remaining cables will cause the tower to twist. The design is such that when the position of equilibrium is reached the stress in every member of the structure and in each of the intact cables shall be below the elastic limit. The design shows a considerable saving of material. Terminal clamps have been designed so that the copper of the lead does not come in contact with the aluminum of the conductor. The terminal clamp has been so designed in order to avoid such electrolytic action as might take place between the two metals. The terminal stress is taken by a steel fitting and the copper lead is free from any mechanical load. *Engineer (England)*, July 29, 1927.

Units, Measurements and Instruments

How Frequency Meters Operate.—E. H. STIVENDER.—This article offers an exposition of the operating principles of the moving iron-vane type, induction-type, electrodynamometer and vibrating-reed type. Both indicating and graphic meters are described by the author.—*Power*, Aug. 2, 1927.

Present Status of the International Electrical Units.—E. C. CRITTENDEN.—A summarization of the present legal standing and practical usage of the international electrical units, particularly as regards use in the United States. The author states that when the international committee on weights and standards takes up the question of electrical units for formal international adoption, it will have to decide whether to maintain as nearly as is practicable the values accepted at present or to revise them so as to be in accord with the fundamental metric system. A probable differentiation is indicated in connection with primary standards regarding the mercury ohm and silver voltameter as against direct determination of the units by methods based on mechanical dimensions.—*Journal of American Institute of Electrical Engineers*, August, 1927.

Auxiliary Testing Apparatus.—A survey of recent developments by manufacturers and utilities in the field of auxiliary testing apparatus for electric meters has been made by the subcommittee on auxiliary testing apparatus of the National Electric Light Association. The report incorporates the results of the survey, presenting in concise form all essential data on each development. This includes combined rotating test-meter and loading devices, timing devices, multi-secondary potential transformers for laboratory testing and several miscellaneous testing instruments devised for the particular purpose of member companies.—*National Electric Light Association*, July, 1927.

Motors and Control

Improved Electric Motors.—A new line of electric motors is described which, while of the squirel-cage type, are capable of developing a good starting torque. This feature is not derived through the insertion of brass or other high-resistance rotor bars in the rotor core, with the consequent danger of heat transmission from the high-resistance bars and the subsequent damage to the stator windings. The characteristics of these motors are obtained by adjusting the bars and the position and shape of the conductors in the rotor. All conductors consist of uninsulated bars of high-conductivity copper fitted into the rotor with a positive lock against end movement. The end rings are of varying design, dependent upon the duty required, and vary from a simple band of copper to a series of divided end rings specially shaped and positioned, so that the rotor has a

higher effective resistance at starting than when operating at rated speed. It is claimed that this type of rotor is incapable of breakdown or damage and will start easily and yet work efficiently under load. As the rotor joint will stand red heat without damage, the end rings can be made exceedingly hot by stalling the motor for some considerable time without in any way damaging the stator coil insulation.—*Engineer (England)*, July 22, 1927.

Electric Drive in Factories. — W. WILSON. — The control of electrical group drives for factory machinery requires special consideration. The expense of power generation, losses through extensive line shafting and belts and the effect of breakdown upon production have caused old factory driving methods to give way to the flexibility and convenience of electricity. The economies to be expected through the installation of electricity, desirable sizes of groups to be driven, location of motors and control design and placement are considered in this treatment of group drives, with particular reference to installations requiring line shafting and to textile machine equipment.—*Electrical Engineer (Australia)*, June 15, 1927.

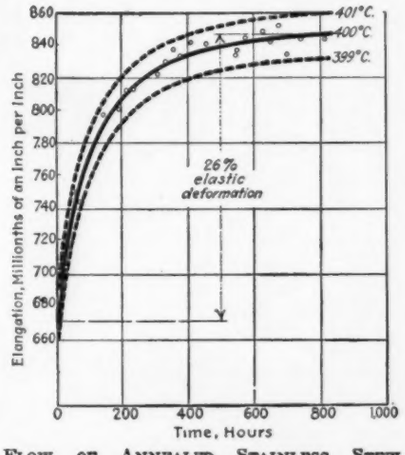
Electrophysics, Electrochemistry and Batteries

Technique of Dufour Cathode-Ray Oscillograph.—G. F. HARRINGTON and A. M. OPSAHL.—A clear and complete trace of surges or vibrations, mechanical or electrical, which are ordinarily beyond the scope of electromechanical oscillographs may be obtained with the device whose use is described in this article. The instrument departs from the more usual form in that the photographic plate or film is placed in the vacuum and is subjected directly to the electron stream. By this means the path of the single trace of the cathode rays is recorded, as is necessary in working with non-repeating short-time transients. The exciting voltage, 30 kv. to 70 kv., is impressed upon the cathode and the anode. Part of the electron stream passes through two holes, one in each of the two diaphragms of the anode. This fine stream of electrons then passes through the fields of the static plates and the various coils and strikes the photographic film. These static and magnetic fields move the electron stream over the film. Exciting currents, operating circuits, sources of operating difficulties and the production of various curves obtainable with this apparatus are fully described.—*Electric Journal*, August, 1927.

Measurement of Inductance by the Shielded Owen Bridge.—J. G. FERGUSON.—The study described in this paper shows that the Owen bridge is well adapted to the accurate measurement of inductance and effective resistance to somewhat above 3,000 cycles. The construction of a shielded bridge for audio frequencies is described and a theoretical discussion is also given. It was found possible to measure inductances ranging from 0.1 henry to 3 henries with an error of measurement less than 0.1 per cent, and for 10 henries the accuracy involves less than 0.25 per cent. As a means of measuring effective resistance the bridge shows an accuracy of about 2 per cent. The sources of error and method of eliminating or correcting them are discussed. —*Bell System Technical Journal*, July, 1927.

Miscellaneous

Design of Plant for High-Temperature Service.—R. W. BAILEY.—The results of short-time tests indicate tnat if steel is to be used in plants operating at higher temperatures than those in general use at present, the metal will have to be used under conditions when the ultimate strength, as ordinarily obtained, is failing appreciably with the increase in temperature. There is a range where softening is a factor, and the ultimate strength given by the



FLOW OF ANNEALED STAINLESS STEEL, LOADED TO 18,000 LB. PER SQUARE INCH AT 400 DEG. C.

short-time test has an arbitrary value depending upon the testing speed. The author states that a factor of safety based upon the ultimate strength determined by the usual tests lacks any real meaning. While factors of safety may be allowed for high-temperature operations, they must be placed upon a duration basis which takes into consideration the distortion permissible. The rate of creep decreases rapidly with decreasing stress, and there is a limiting stress below which creep does not occur. The results of creep tests must be considered in connection with the allowable rate of distortion in order to justify the assumption of an elastic material. The results of many experiments as to rate of creep and the behavior of metals under creep stress are given here. The author states that the relation between stress and strain can no longer be represented by Hooke's law and that an exponential expression tending toward this law, as the limit at low stresses, must be used.—*Engineering (England)*, July 8, 1927.

Routine Tests of Insulating Materials.—LIONEL G. HILL.—During an extensive period of research work in connection with insulating media for high-voltage apparatus the author encountered what he considered to be just cause for criticism of various methods used in routine testing and in those recommended for that purpose. He has endeavored to explain certain procedures which he considers to be improvements upon the generally accepted routine tests. For testing mineral oil he offers a method of measuring the quantity of air passed through the liquid in the sludge test. He recommends higher breakdown voltages and wider test gaps for dielectric checks of insulating oils and suggests a definite determination by one of four possible methods to ascertain the quantity of moisture in the oil. The bituminous compounds used in cables and joints are also the object of constructive criticism.—*Electrician (England)*, July 22, 1927.

Heat Applications and Material Handling

Charging Machines for Industrial Furnaces. — A motor-driven unit charger for industrial furnaces capable of handling 15-ton steel plates has been developed. The controlling mechanism, including starters and resistances, is mounted at one end of the machine carriage. The latter moves as a unit upon rails, placed at right angles to the charging direction. Current is supplied through an armored cable, which is paid out as necessity arises. The charging carrier moves into the furnace upon grooves in the furnace bed when the carriers are inserted or withdrawn. No difficulty has been encountered through temperature variations when handling heated material. Furnaces exceeding 15 ft. in depth may be charged with this device.—*Engineering (England)*, July 29, 1927.

Telegraphy, Telephony, Radio and Signals

Modulation in Vacuum Tubes Used as Amplifiers. — EUGENE PETERSON and HERBERT P. EVANS.—Recent developments in amplifier design tending toward more rigorous quality requirements have shown that the solutions of Van der Bijl and Carson are inadequate for certain purposes since they are based upon a convenient assumption which is not satisfied in fact. In particular, a detailed investigation of carrier-current repeaters used for the simultaneous transmission of several channels, and upon which in consequence the modulation or cross-talk requirements are particularly severe, showed the modulation currents measured to be quite different from those specified by the theory, as was the law of variation of these currents with the circuit constants. The cause of the discrepancy was found to rest in the neglect of the variation of the amplification factor with both plate and grid potentials. New expressions have been developed in terms of the amplification factor, the internal-output resistance of the tube and their differential parameters. Conclusions indicate the desirable tube characteristics by which a single tube may take the place of two tubes in push-pull connection. Certain properties of different types of tubes under conditions of maximum output power are compared on the basis of the amplification factor possessing constant and variable values.—*Bell System Technical Journal*, July, 1927.

News of the Industry

Lock 17 Project Approved

Alabama Power Company Gets Certificate from State Commission for Plant on the Warrior

PERMISSION for the construction of a hydro-electric power development at Lock 17, on the Warrior River, where the federal government has navigation works, was granted the Alabama Power Company by the Alabama Public Service Commission on Aug. 13. Construction of the project is to begin within the next twelve months according to the terms of the certificate. A license from the Federal Power Commission is now awaited. It is proposed to install two 14,000-hp. generators immediately downstream from the west abutment of the dam and connected with its headworks section by steel penstocks. Details of the project were printed in the ELECTRICAL WORLD for July 16 (page 129).

Date Set for Colorado River Conference at Denver

Monday, Aug. 22, has been set as the date for the new Colorado River conference to be held in Denver, and formal invitation from the governors of the four Upper Colorado basin states has been forwarded by Governor George H. Dern of Utah to the three lower basin states' executives. A joint session of the Arizona and Colorado commissions closed at Phoenix, Ariz., Aug. 5, after an all-day meeting behind closed doors.

Jefferson's Home Illuminated by 1,368,000-Cp. Beam

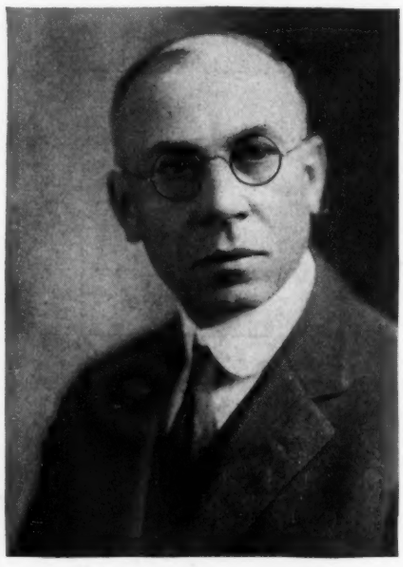
Another spectacular demonstration of long-distance transmission of an electrical impulse in an unusual way was staged on Tuesday of this week when the flashing of a miniature spotlamp—rated at 1 cp.—on a selenium cell in the Aldermanic Chamber at New York City put in operation at Charlottesville, Va., a searchlamp rated at 1,368,000 cp. This powerful beam was used to illuminate Monticello, the home of Thomas Jefferson, on a hill three miles away, and will be known as the "Thomas Jefferson searchlight." It was manufactured by the Sperry Gyroscope Company and erected by the Virginia Public Service Company under the auspices of the Jefferson Foundation, formed to preserve Monticello as a national memorial.

At the Aldermanic Chamber in the New York City Hall there was a brief celebration, after which the small spotlamp was turned on the selenium cell, which was affixed to the arm of a statue of Jefferson. This closed a circuit over a Western Union telegraph wire and thus operated the apparatus in Virginia. The Westinghouse Electric & Manufacturing Company planned the arrangements for transmitting the spark. A return impulse from Charlottesville illuminated a picture of Monticello in the Aldermanic Chamber.

Hockenbeamer Is President

Vice-President and Treasurer of Pacific Gas & Electric Succeeds the Late W. E. Creed

AUGUST F. HOCKENBEAMER, vice-president and treasurer of the Pacific Gas & Electric Company, has been elected by the board of directors to the presidency of the company to fill the vacancy left by the sudden death of Wigginton E. Creed, recorded last week. At the same time John P. Coghlan, assistant to the president, was made second vice-president and E. Hodges, auditor, was appointed comptroller in charge of the company's accounting tax and insurance departments.



AUGUST F. HOCKENBEAMER

Mr. Hockenbeamer has been vice-president of the company for seventeen years, and treasurer and a director for nineteen. Born at Logansport, Ind., March 6, 1871, he began his career with public utilities at the age of sixteen, when he entered the employ of the Pennsylvania Railroad as a messenger boy in the office of L. F. Loree. In the early part of 1904 he became associated with the investment banking house of the N. W. Halsey Company in New York City. He went to San Francisco in 1907 in the interests of his company, which at that time was one of the controlling stockholders in the Pacific Gas & Electric Company. In February, 1908, he became comptroller of the company and in July of the same year received the additional title and duties of treasurer. Two years later he was made vice-president. Mr. Hockenbeamer's outstanding achievement as an expert on utility financing was his initiation in June, 1914, of the policy of customer ownership, since almost universally adopted by utilities throughout the country.

Mr. Coghlan was born in North Columbia, Cal., in 1876. After a brief newspaper career he joined the legal department of the company in 1906. For many years he was manager of the claims department, and in 1922 he was made assistant to the late Wigginton E. Creed. Mr. Hodges has been in the auditing department of the company for the past eleven years.

Federal Court at Boston Enjoins Worcester Rate

A temporary injunction against the Massachusetts Department of Public Utilities on behalf of the Worcester Electric Light Company was granted on Tuesday of this week by Judges Bingham, Johnson and Lowell of the United States District Court at Boston, restraining the commission from enforcing its recent order reducing the maximum rate of the company from 7 cents to 5 cents per kilowatt-hour. In its finding the court declared that the rule adopted in such cases by the United States Supreme Court is that there shall be a fair return allowed on the present value of the property used by the company and that the Massachusetts commission did not follow this rule in making its decision. The company has notified its customers that it will continue the present 7-cent rate pending final disposition of the case and that compensation will be rendered them in the form of rebates in the event of the commission's being sustained.

In connection with the hearing of this case by the District Court an affidavit was presented by R. W. Rollins, president of the Worcester company, declaring that if the order of the board should be complied with and the net earnings for the next year's operations should total the commission's estimate of $600,000, the company would receive far less than a reasonable return upon the value of its property. He contended that the property value cannot be less than $15,000,000 and that the company's estimated net earnings are but $525,000, or less than 4 per cent on this figure. The entire case hinges on the rate base which should be allowed, the issue being between the present-value and invested-capital theories. The next step will be the appointment of a master to hear the case prior to further court procedure, leading probably to final disposition by the highest tribunal at Washington.

New A.I.E.E. Committees

President Gherardi Announces Appointments for the Administrative Year Just Begun

AT THE first meeting of the board of directors of the American Institute of Electrical Engineers for the administrative year beginning Aug. 1, held in New York last week, President Gherardi announced his committee appointments, the chairmen being as follows:

GENERAL COMMITTEES

Executive.—Bancroft Gherardi, American Telephone & Telegraph Company, New York.
Finance.—H. A. Kidder, Interborough Rapid Transit Company, New York.
Meetings and Papers.—H. P. Charlesworth, American Telephone & Telegraph Company, New York.
Publication.—E. B. Meyer, Public Service Production Company, Newark.
Co-ordination of Institute Activities.—G. L. Knight, Brooklyn Edison Company, Brooklyn.
Board of Examiners.—E. H. Everit, Southern New England Telephone Company, New Haven.
Sections.—W. B. Kouwenhoven, Johns Hopkins University, Baltimore.
Student Branches.—J. L. Beaver, Lehigh University, Bethlehem, Pa.
Membership.—E. B. Merriam, General Electric Company, Schenectady.
Headquarters.—G. L. Knight, Brooklyn Edison Company, Brooklyn.
Law.—C. O. Bickelhaupt, Southern Bell Telephone & Telegraph Company, Atlanta.
Public Policy.—H. W. Buck, Vielé, Blackwell & Buck, New York.
Edison Medal.—M. I. Pupin, Columbia University, New York.
Code of Principles of Professional Conduct.—John W. Lieb, New York Edison Company, New York.
Columbia University Scholarships.—W. I. Slichter, Columbia University, New York.
Award of Institute Prizes.—H. P. Charlesworth, American Telephone & Telegraph Company, New York.
Safety Codes.—J. P. Jackson, New York Edison Company, New York.
Licensing of Engineers.—Francis Blossom, Sanderson & Porter, New York.
Advisory Committee to the Museum of Peaceful Arts.—J. P. Jackson, New York Edison Company, New York.

TECHNICAL COMMITTEES

Automatic Stations.—Chester Lichtenberg, General Electric Company, Schenectady.
Communication.—H. W. Drake, Western Union Telegraph Company, New York.
Education.—Paul M. Lincoln, Cornell University, Ithaca, N. Y.
Electrical Machinery.—F. D. Newbury, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.
Electric Welding.—J. C. Lincoln, Lincoln Electric Company, Cleveland.
Electrochemistry and Electrometallurgy.—G. W. Vinal, Bureau of Standards, Washington.
Electrophysics.—V. Karapetoff, Cornell University, Ithaca, N. Y.
Instruments and Measurements.—J. R. Craighead, General Electric Company, Schenectady, N. Y.
Applications to Iron and Steel Production.—A. G. Pierce, Cutler-Hammer Manufacturing Company, Cleveland.
Production and Application of Light.—P. S. Millar, Electrical Testing Laboratories, New York.
Applications to Marine Work.—W. E. Thau, Westinghouse Electric & Manufacturing Company, New York.
Applications to Mining Work.—W. H. Lesser, Madeira Hill & Company, Frackville, Pa.
General Power Applications.—A. M. MacCutcheon, Cleveland.
Power Generation.—W. S. Gorsuch, Interborough Rapid Transit Company, New York.
Power Transmission and Distribution.—Philip Torchio, New York Edison Company, New York.
Protective Devices.—F. L. Hunt, Turners Falls Power & Electric Company, Greenfield, Mass.
Research.—F. W. Peek, Jr., General Electric Company, Pittsfield, Mass.
Transportation.—J. V. B. Duer, Pennsylvania Railroad System, Altoona, Pa.

In accordance with the by-laws of the Edison medal committee, the board of directors confirmed the appointment by President Gherardi of new members of the committee, for terms of five years each, as follows: E. B. Craft, Bell Telephone Laboratories; Paul M. Lincoln, Cornell University, and C. E. Skinner, of Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. The board also elected three of its membership to serve as members of the Edison medal committee for terms of two years each: H. P. Liversidge, Philadelphia Electric Company; E. B. Meyer, Public Service Production Company, Newark, and I. E. Moultrop, Edison Electric Illuminating Company of Boston.

New Co-operative Merchandising Plan

President of a California Supply Company Describes to Electragists a Method Developed in Combination with the Central Station of Which It Is a Subsidiary

A REMARKABLE story of what is probably the most original co-operative selling program that the electrical industry has seen was presented last week at the close of the twenty-seventh annual convention of the Association of Electragists International at the Hotel Chase, St. Louis. H. H. Courtright, president of the Valley Electrical Supply Company of Fresno, Cal., described the plan under which that company is operating in conjunction with 96 electrical appliance dealers in the territory served by the San Joaquin Light & Power Corporation. The Valley Electrical Supply Company is a subsidiary of the San Joaquin company. Under this plan the power company contracts to pay the Valley company $5 per connected kilowatt on all domestic appliances, including ranges and water heaters, that are sold into the homes of its consumers through either the Valley company's own retail stores or the stores of the affiliated dealers. In turn the Valley company conducts an extensive advertising campaign over the names of the power company and the dealers of each locality and provides them at cost with special sale appliances for five sales drives on small heating appliances each year. There are special leaders purchased from nationally known manufacturers which are distributed in small quantities for use to stimulate the sale of standard merchandise. This stock is all purchased through the jobbers, and the plan has resulted in a very large income in appliance sales and residence consumption throughout the district.

Earl Whitehorne, commercial editor of the ELECTRICAL WORLD, discussed at length the critical position of the electrical contractor in face of the dwindling market for house wiring. Supporting his contentions with many charts, he pictured the 30 per cent decrease in the number of houses wired each year since 1924, contrasted with the 30 per cent increase in the number of wiring contractors over the same period. In 1924 22,000 contractors wired 1,783,000 houses, whereas this year there are 30,000 contractors and there will be 1,200,000 houses wired, with very few unwired houses remaining within reach of power lines. Two possibilities lie ahead, he said: Either half the contractors must soon die out of the industry from starvation or the united industry must marshal this vast equipment for wiring and direct it to the installation of adequate wiring in twelve million homes where the use of more appliances and the sale of more energy is blocked by an inadequate number of outlets.

L. W. Going, chief electrical inspector of Portland, Ore., told an interesting story of "How the Portland Code Safeguards the Public from Electrical Hazards" by an extensive reinspection service and the restriction of the sale of substandard appliances by the licensing of retail merchants. After listening to statements by C. J. Geibush of California and E. H. Herzburg of Milwaukee describing the success which has attended the operation of local motor sections in Los Angeles, San Francisco and Milwaukee for the purpose of improving the conditions under which electric motors are distributed and sold, the organization of a national motor section was authorized for the study of motor distribution problems and their solution jointly with the manufacturers. The association voted to hold its 1928 convention in Chicago.

N. E. M. A. Policies Division at Association Island

The program of the coming meeting of the Policies Division of the National Electrical Manufacturers' Association at Association Island, Sept. 1, 2, and 3, will be built around three subjects—economics, commercial development and competitive relations. Papers presented will embody definite recommendations on which the division will be asked to take action. Prof. Thomas N. Carver, of the department of political economy at Harvard, author of many books on this subject, will speak on "The Place of the Small Manufacturer in Our Economic System." Magnus Alexander, president of the National Industrial Conference Board, will talk of "Business Competition and Business Prosperity." "How to Make the N.E.M.A. a Paying Investment" and "Eliminating the Use of Substandard Material" will be subjects of addresses by Clarence L. Collens, vice-president of the Policies Division, and Alfred E. Waller, managing director of the association.

W. E. Sprackling, president of the Tubular Woven Fabric Company, has chosen the subject of "Market Development;" Leonard Kebler, president of the Ward Leonard Electric Company, will speak on "Cross-Licensing of Patents," and W. G. Merritt, of the League for Industrial Rights, on "Labor Problems of Electrical Manufacturers."

A feature of the program will be a

short symposium on the commercial needs of electrical manufacturers, with H. T. Bussmann, of the Bussmann Manufacturing Company, speaking for the Supply Division; N. A. Wolcott, of the Packard Electric Company, for the Apparatus Division, and Douglas Rigney, of A. H. Grebe & Company, for the Radio Division.

Edison Speaks Into Microphone at Anniversary

For the second time Thomas A. Edison was induced to speak into the microphone on Friday of last week, when, at Llewellyn Park, West Orange, N. J., where he makes his home, he was made the central figure of a semicentennial anniversary of the invention of the phonograph. He broadcasted the information that Edison was speaking, and, on request, he recited the nursery rhyme concerning Mary and her lamb that he had repeated to the original phonograph in 1877. Mr. Edison's first radio "talk" was at the 1926 convention of the National Electric Light Association at Atlantic City and consisted of the words "Good night."

Brief speeches were made at last week's celebration by Governor Moore of New Jersey and others, and congratulatory letters from the heads of Belgium, Czechoslovakia, Ireland, Cuba and Italy, Secretary Hoover and a number of other distinguished men were presented to the inventor.

Applications Before Federal Power Commission

The Bunker Hill & Sullivan Mining Concentrating Company of Kellogg, Idaho, has applied to the Federal Power Commission for license covering a small project in Deadwood River, in Valley County, Idaho. It is proposed to construct a dam 124 ft. long which will develop 320 hp. of primary power to be used in connection with the company's milling operations.

The Superior Packing Company of Seattle has applied for a license covering a small constructed project on the north shore of Tenakee Inlet on Chichagof Island, Alaska. The power is to be used for canning purposes.

The Southern Sierras Power Company of Riverside, Cal., has applied for a license covering a 20-mile transmission line in San Bernardino and Kern Counties, Cal. The line is to carry a power supply for mining operations of the Pacific Coast Borax Company.

Applications to the Federal Power Commission for preliminary permits have been made by the Public Service Company of Colorado, Denver, for a power project on public lands on the Arkansas River, in Fremont County, Col., and by the Cascade Power Company, Seattle, for a power project partly within Snoqualmie National Forest, on May Creek and Lake Isabel, in Snohomish County, Wash. The Idaho Power Company asks a license for a transmission line on public lands in Baka County, Ore. All the applications are for public utility company purposes.

Purchases and Mergers

Plan a Consolidation to Unite Mohawk-Hudson Companies—Movements in Middle West and South

STOCKHOLDERS of seven utility companies in New York State have been asked to vote on a consolidation to form the New York Power & Light Corporation. The companies involved, which have an aggregate capital and surplus of approximately $100,000,000, are the Municipal Gas Company of Albany, the Troy Gas Company (both of which have electric departments), the Adirondack Power & Light Corporation, the Adirondack Electric Power Corporation, the Fulton County Gas & Electric Company, the Cohoes Power & Light Corporation and the Eastern New York Utilities Corporation, which does a gas and electric business in Rensselaer and Columbia Counties. All are subsidiaries of the Mohawk-Hudson Power Corporation. The merger will result in one company serving all communities lying between the Hudson and Lake Champlain, and from Rensselaer west, including Albany, Troy, Cohoes, Schenectady, Johnstown and Gloversville and all communities west to Oneida and Canastota. Under its terms the Municipal Gas Company of Albany would purchase the other corporations and then transfer them to the new company.

Application has been made to the New York Public Service Commission by the Lake Ontario Power Corporation for permission to acquire all of the preferred and common stock of the Sodus Gas & Electric Light Company, the common stock of the Marion Power Company, also of Sodus, and the Northern Cayuga Light & Power Corporation of Cato, and certain property and land and water rights of the Preston Power Corporation of Atlanta, Steuben County, and to merge the companies. The Lake Ontario Power Corporation is authorized to operate in Clyde, Lyons, Macedon, Newark, Palmyra, Red Creek, Savannah, Sodus, Wolcott, Cato, Meridian, Webster and nearby towns in Wayne, Monroe and Cayuga Counties.

Contract to purchase from the present owners the Mission Range Power Company and Flathead Valley Electric Company of Polson, Mont., has been signed by the W. B. Foshay Company of Minneapolis. These properties are being purchased for the Public Utilities Consolidated Corporation, a company formed by the Foshay interests to operate public utilities throughout the United States.

The Northwestern Light & Power Company, with headquarters at Cedar Rapids, Iowa, is now owner of the George (Iowa) electric light plant, formerly operated by the Iowa Public Service Company.

Citizens of Ridgeway, Mo., have voted, 187 to 37, in favor of selling the municipal power company to the Missouri Public Service Company, with headquarters at Trenton, Mo.

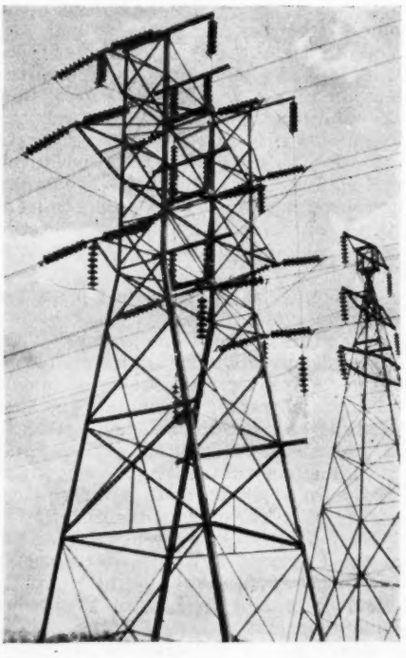
The Virginia Public Service Company, operating a chain of electric power plants between Chatham and Emporia, Va., has purchased the plant at South Hill, Va.

Announcement is made that the Federal Public Utilities Company of Mississippi has purchased the Leakesville (Miss.) light and ice plant.

Rejection of bids from the Mississippi Power & Light Company and the Mississippi Public Service Company for the Clarksdale (Miss.) municipal light plant was recommended by the advisory committee appointed by the city commissioners to investigate the advisability of selling the plant. The Mississippi Power & Light Company offered a bid of $750,000 cash and $250,000 in municipal lighting by the city in the next ten years without interest. The Mississippi Public Service Commission offered a bid of $775,000 in cash under a 25-year franchise. To this bid was attached an auditor's statement that the city would be saved $57,000 a year.

Agreements are reported to have been entered into by the American Utilities Company for the acquisition of the remaining stock of the Mansfield (La.) Light & Power Company, in which it already has a minority interest. The Mansfield company supplies light and power in Mansfield, South Mansfield and Naborton, La.

Helping Inductive Co-ordination in Niagara District



TWO transportation towers of an unusual kind have been built by the Niagara, Lockport & Ontario Power Company on the three-circuit section between Mortimer and Pittsford, N. Y. The towers have been erected as a means of eliminating interference with wires of the Western Union Telegraph Company, which are within 100 ft. of the Niagara, Lockport & Ontario wires along the four-mile stretch. The nine wires supported by the towers have been interchanged so that no one wire occupies the same position for more than one-third of the total distance. Each tower weighs 9 tons and is 66 ft. high. They are said to be the only ones of their kind in existence.

To Speed Up Diablo Dam

Seattle Determines to Go Ahead with This Project and May Also Build New Dam on Gorge Creek

TWO important decisions in the development of the Skagit hydroelectric project by the city of Seattle have been made by city officials. The City Council has agreed to speed construction of a masonry dam across Diablo Canyon on the Skagit, and the Council utilities committee has approved a bill providing $50,000 for preparation of plans for an Ambursen dam near Gorge Creek. Approval of the plans for the new dam at Gorge Creek is taken to indicate a reversal of the Council's previous intention to concentrate on the Diablo site. Bonds of $3,450,000 have already been provided by the Council for the completion of a dam at Diablo Canyon and possibly another at Ruby Creek, further upstream. Additional funds were to be provided for the power house. Now, however, the additional bonds will be used for the Ambursen dam and new generating machinery in the Gorge power house.

A Council group, headed by Chairman Oliver T. Erickson of the utilities committee, maintains that immediate increase in power production is the greatest need of the light department to enable it to compete with the private power company in procuring contracts. A new dam at Gorge Creek would raise the head of water flowing into the tunnel sufficiently to operate two additional generators during the high-water season, but would create no increase during low water until the Diablo dam is completed.

Meanwhile the city utilities committee has formally approved an ordinance authorizing the enlargement of the Cedar Falls light and lower plant. The ordinance proposes to replace two small generating units at the Cedar Falls plant with a combined capacity of 9,000 kw. with a new machine of 12,500 kw. rating; also to enlarge the power house, to rebuild No. 2 pipe line from the masonry dam to the power house and to increase its size from 68 in. to 78 in. The bill appropriates $400,000 as the cost of the work, but opponents of the project declare its cost will exceed $500,000. Councilman Erickson strongly favors these expenditures, but the minority group, which stands by the policy of the old City Council of concentrating on the Skagit, instead of scattering developments, is expected to put up a strong fight.

By agreement reached between Mayor Bertha K. Landes and the City Council, the board of public works will immediately issue a call for bids for constructing the dam at Diablo Canyon.

Wisconsin Utilities Association Electric Meeting

At Madison, Wis., on Sept. 2 and 3 the Electric Section of the Wisconsin Utilities Association will hold a two-day session. Rural electrification will be covered by Grant Ford, who will talk on "Substations for Rural Lines and Small Communities," and George G. Post, who will have as his subject "Rural Distribution—Comparison of Systems." A discussion will be led by G. C. Neff, and the report of the rural electric service committee will be given by G. V. Rork. Charles Virgin of the Wisconsin Public Service Corporation will present a paper on "Oil Engines and Utility Service," and R. R. Benedict, who holds the electric fellowship at the University of Wisconsin, will make a report on his work.

"Mississippi Floods and Their Prevention" will be the subject of an address by Prof. Daniel W. Mead, and D. G. Evans will have for his topic "Profit Sharing by Overhead Crews for the Purpose of Reducing Construction and Maintenance Costs," followed by a discussion led by M. B. Monson of the Northern States Power Company. C. H. Pfeiffer of the Wisconsin Public Service Corporation will speak on "Hazard Encountered in Substation Operation," and L. P. Fessenden on "Unit-Type Pulverizers." Other subjects include electric meter work and public relations.

General Electric's Course in Rural Electrification

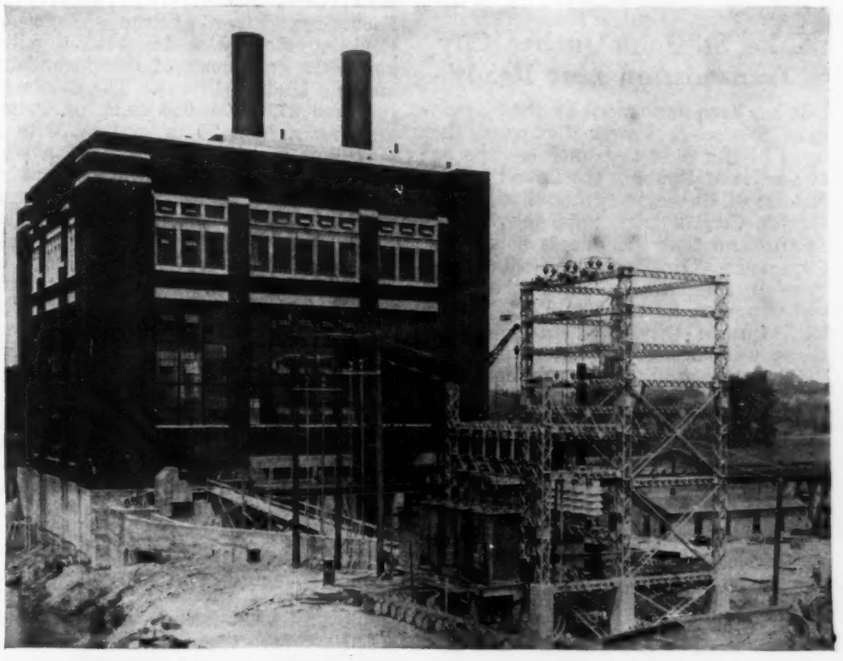
A course in rural electrification has been started by the General Electric Company at its Schenectady plant, in the belief that the farmer will better understand electrification when it is explained by men who know farming as well as engineering. Five men, all born and bred on farms, have been selected for this training, which is the first of its kind fostered by a large electrical manufacturing company.

The need for trained men of this type was expressed some years ago by Owen D. Young, chairman of the board, who was raised on a farm in New York State. The course will be supervised by the sales training department at Schenectady, which has facilities for both theoretical and practical work. It will take eight months.

Los Angeles' Suit Against Gas & Electric

The city of Los Angeles and its Board of Water and Power Commissioners filed suit in the Superior Court on Aug. 9 against the Los Angeles Gas & Electric Corporation, asking that that corporation be restrained from using the streets and other public places for its electrical distributing system. The company's occupancy and use of the streets is declared to be contrary to the state constitution and the city charter except in so far as it provides "illuminating light." The complaint further says that the corporation is engaged in supplying electricity to consumers in competition with the municipally owned Bureau of Power and Light and is oc-

Mad River Station at Springfield, Ohio, Starts Up



A 20,000-KW. turbo-generator, the initial unit in the new Mad River steam-electric power plant of the Ohio Edison Company at Springfield, Ohio, was completed and placed in operation on Aug. 1. Construction work on this two-million-dollar undertaking, which is twice the size and has twice the capacity of the old Rockway plant of the company, occupied about a year. The new plant contains the latest type of equipment. C. I. Weaver, vice-president and general manager of the Ohio Edison Company, said that it was made necessary by the expansion of the company's territory to cover a score of towns and villages within a radius of 50 miles of Springfield in the Mad River Valley. The formal opening of the new plant, when a civic celebration is planned in Springfield, will be held about Oct. 1.

cupying the streets and alleys, although it has had no franchise or other authority for so doing for ten years.

The city asks for $135,000 damages on account of the loss of 2 per cent of the gross annual receipts from the sale of electricity by the corporation exclusively for power purposes. This 2 per cent, it is stated, would have been required if the company had been operating under a city franchise. Another cause for action is alleged to exist because the corporation prior to Oct. 10, 1911, had assumed an obligation to serve only the territory within the existing city limits at that time and not to include any territory subsequently annexed to the city. The Gas & Electric has continued to extend its system into this annexed territory and is now furnishing electricity for lighting, heating, cooking and power in spite of the alleged lack of a franchise.

In compliance with a court order, the Board of Water and Power Commissioners has just made a payment to the city treasurer of approximately $15,000, representing a refund of money spent by the board in 1923 in behalf of a bond issue intended to cover initial engineering expenses for a survey of the Boulder Canyon on the Colorado River. This money was spent by the board for newspaper advertisements and printed matter. The Supreme Court decided that the board did not have the technical authority to do so. The sum refunded is said to have been raised by voluntary contributions from the employees' association of the Water and Power Department and other citizens.

Lake St. John-Quebec City Transmission Line Ready

It has been announced by the Shawinigan Water & Power Company that tests of the new transmission line between Ile Maligne, in the Lake St. John district of Quebec, and Limoilou, in the Quebec City district, have proved successful and that the line is now ready for service. Construction of this transmission line, which links the huge water powers of the Grande Décharge with Quebec City, a distance of 140 miles, was started in May, 1926. More than a thousand men were employed at a time in the construction work. The lines are built for transmission at 187 kv., but for the present will be operated at 160 kv. Part of the power will be utilized for the operation of the Ste. Anne Paper Company at Beaupré, 23 miles east of Quebec City, and the remainder will be used by the new mills of the Anglo-Canadian Pulp & Paper Company, which are now being erected at Limoilou.

New Farm Rate for Hartford Electric Light Company

Asserting that before farmesrs can be furnished with electric power at attractive prices it is necessary to ascertain, first, how enough power can be used economically to make rural lines self-supporting and, second, a method of financing the relatively large investment in power machinery which is essential, the Hartford (Conn.) Electric Light Company announces a co-operative farm-service rate of the combination flat and meter type which it hopes will demonstrate that farm business can be developed to a self-sustaining volume. This rate will be $3.50 a month per kilowatt of demand (minimum demand 2 kw.) plus energy at 2 cents a kilowatt-hour (minimum, 80 kw.-hr per month per kilowatt of demand). The company waives the demand charge for a period of five years to the extent that the customer is purchasing apparatus to be electrically operated, and at the expiration of the five-year period the customer has the option of electing in the place of the farm rate any applicable rate available to other customers.

Future Development on Sacandaga

Regeneration of Upper Hudson River in New York State Will Enable Adirondack Power & Light Company to Build Hydro Plants of 500,000 Hp.

PLANS of the Adirondack Power & Light Company to avail itself of the power-generating facilities that will be provided by the regulation of the Hudson River in upper New York State and the creation of the Sacandaga Reservoir are outlined by S. O. Schamberger, hydraulic engineer with the Adirondack company, in the July issue of the *Synchronizer*, a publication representing the Adirondack and associated Mohawk-Hudson utilities. The award of bonds last April by the Hudson River Regulating District, a state government organization, to begin work on the reservoir was announced in the ELECTRICAL WORLD. It will be the largest of sixteen proposed storage reservoirs on the Upper Hudson and the first to be built and will cost $9,000,000.

This reservoir will be formed by a dam about 100 ft. high across the Sacandaga River at the village of Conklingville, which is about 5 miles above the confluence of the Sacandaga and the Hudson Rivers. The dam will impound 37,800,000,000 cu.ft. of water, creating a lake 25 miles long with a maximum width of 5 miles and a surface area of approximately 42 square miles, which is almost exactly the area of Lake George. The main dam will be 1,100 ft. long, and the spillway of this dam will have a crest elevation of 771 ft. above sea level. Many hamlets and scattered farmsteads will be obliterated when the lake is formed, and several cemeteries will have to be removed.

The Sacandaga and Hudson Rivers below Conklingville fall 580 ft. in 35 miles to Fort Edward. With the addition of 70 ft. head created at the dam, there is 650 ft. of head which may be used to develop power. Of this total head the Adirondack Power & Light Corporation owns 253 ft., of which only Spier Falls, with a head of 80 ft., and Feeder Dam, with a head of 15 ft., are now developed. New developments at Hadley, Stewart Bridge and Conklingville have been designed by the Adirondack Power & Light Corporation, and their construction is awaiting the completion of the reservoir.

ULTIMATE OUTPUT 500,000 HP.

The ultimate development of this section of the river will probably be in the neighborhood of 500,000 hp. or more, with an annual output of 1,500,000,000 kw.-hr. To supply a single isolated district, or even a single system similar to the Adirondack Power & Light Corporation or the Mohawk-Hudson system, such a development would probably never be economical. Interconnection with great load centers, however, makes it possible to utilize the natural advantages of the Hudson area. The Hudson River stations will be relatively close to the load centers, and the physical layout is such that the hydro stations can be used to carry the peak loads with an improvement in load factor and efficiency in the steam plants in the system, as well as a decrease in the original cost of the development per kilowatt of system capacity. Much time and money have been spent to determine the type of developments that should be made, size and location of the necessary transmission lines, and the necessary connections to put the harnessed energy of the water to work.

Oregon Power Companies Eager for Irrigation

Notwithstanding the unproductiveness of the vast areas of waste lands in eastern Oregon now awaiting irrigation and settlement, reports on file in the office of the Public Service Commission of the state show that at least seven electric light and power utilities are busily engaged at present in the reconstruction of old transmission lines and the installation of equipment. An act of Oregon's 1926 Legislature and the fact that the National Reclamation Commission has taken definite steps to complete several imposing reclamation and irrigation projects in eastern Oregon are factors tending greatly to encourage electric power development in this heretofore unpromising field.

Among the utilities that will profit when these various important irrigation projects are fully developed and the lands turned over to settlers are the Eastern Oregon Light & Power Company, Idaho Power Company, Deschutes Power Company, Pacific Light & Power Company, People's West Coast Hydro-Electric Corporation, Maupin Electric Company and the Bend Water, Light & Power Company. The territory directly affected comprises the Counties of Baker, Crook, Deschutes, Gilliam, Grant, Harney, Jefferson, Hood River, Klamath, Lake, Malheur, Morrow, Sherman, Umatilla, Union, Wallowa, Wasco and Wheeler. In these eighteen counties there are 1,035,876 acres of irrigable land.

Briefer News

Vermont Electrical Association's Outing.—The annual summer outing of the Vermont Electrical Association will, the secretary announces, be held at Knowlton's Landing on Thursday, Aug. 25, by boat from Newport, Vt.

Another Rate War Looked for in Nebraska, This Time at Neligh.—The city of Neligh, Neb., has given a contract for the installation of a Diesel-engine plant, to be completed by November. The city is served by the Interstate Power Company, but dissatisfaction with rates and service led to granting a competing franchise. A rate war is looked for along the lines of the one at Hartington, Neb., previously reported in these columns.

Protest Against Optional Rates Fails at Huntington, Ind.—The petition by customers of the Northern Indiana Power Company at Huntington, Ind., against that company's being permitted to try out optional residential and commercial rates for lighting and cooking, based on an "active-room" charge, has been overruled by the Public Service Commission, which holds that the experiment should be tried for a long enough period to determine its practicability and fairness.

Way Cleared for Toccoa River Plant in Georgia.—Construction of the dam of the Toccoa Electric Power Company across the Toccoa River, 2½ miles from Blue Ridge, Ga., is expected to start immediately, following an award of $40,700 to the land owners who began litigation to prevent the power company from condemning their property and thus frustrated the company's efforts to begin construction last year. The land owners involved now wish to make an appeal from the findings of the arbitration board, but it is thought that the courts will find the board's figure a fair one.

Geneva, N. Y., to Have New Lighting System.—Street lighting in Geneva, N. Y., is to be doubled in value by a new installation undertaken by the Empire Gas & Electric Company. More than 800 single 100-cp. lamps, 47 single 60-cp. lamps and nearly 100 single 600-cp. lamps will be installed, and the cluster lights which have for years lighted the business section will be abolished. The new system, it is estimated, will cost $4,000 a year more than the old. It is to be finished in June, 1928.

Plans for National Museum of Engineering.—A campaign to raise $10,000,000 to build the proposed National Museum of Engineering and Industry is announced, and Samuel Insull, a past-president of the organization promoting the museum, has issued a statement urging support of the undertaking. The purpose is to establish and maintain a permanent organization and home for commemorating the achievements and perpetuating the records of engineering and industrial progress. Considerable space in the institution is to be devoted to the display of public utility engineering achievements. Already a collection of exhibits has been made, but there is nowhere to put it.

Break in Barge Canal Cuts Down Hydro Output at Rochester, N. Y.—A serious break in the New York Barge Canal at Eagle Harbor, near Rochester, recently necessitated closing the gates which admit water from the Niagara River and replacing this water from the Genesee River while the break underwent repair. The consequent lowering of the water of the Genesee forced manufacturers with hydro-electric plants to buy energy or generate steam power. The Rochester Gas & Electric Corporation's supply of water for generating purposes was reduced, but until normal conditions were restored the company maintained its peak load service by the generation of a large amount of power by steam and the purchase of additional power from Niagara.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see the ELECTRICAL WORLD for July 2, page 50.]

Camp Co-operation VII—Association Island, Henderson Harbor, N. Y., Aug. 28-31. Society for Electrical Development, 420 Lexington Ave., New York.

National Electrical Manufacturers' Association—Policies Division, Association Island, N. Y., Sept. 1-3; Apparatus Division, Briarcliff, N. Y., Oct. 24-27. S. N. Clarkson, 420 Lexington Ave., New York.

Wisconsin Utilities Association, Electric Section—Madison, Wis., Sept. 2 and 3. J. N. Cadby, 432 Broadway, Milwaukee.

Eastern Division, N.E.L.A.—Bedford Springs, Pa., Sept. 7-10. H. A. Buch, 212 Locust St., Harrisburg, Pa.

New England Division, N.E.L.A.—New London, Conn., Sept. 12-15. Miss O. A. Bursiel, 20 Providence St., Boston.

Pennsylvania State Association of Electrical Contractors and Dealers—Lawrence Hotel, Erie, Pa., Sept. 12-14. M. G. Sellers, 1202 Locust St., Philadelphia.

American Institute of Electrical Engineers—Pacific Coast convention, Del Monte, Cal., Sept. 13-16. F. L. Hutchinson, 36 West 39th St., New York.

Empire State Gas and Electric Association—Electric Meter Section, Hotel Syracuse, Syracuse, Sept. 15-16; annual convention, Lake Placid Club, Lake Placid, N. Y., Oct. 6 and 7. C. H. B. Chapin, Grand Central Terminal, New York.

Great Lakes Division, N.E.L.A.—French Lick Springs, Ind., Sept. 22-24. R. V. Prather, 205 Illinois Mine Workers' Bldg., Springfield, Ill.

Association of Edison Illuminating Companies—Colorado Springs, Col., Sept. 26-30. P. S. Millar, 80th St. and East End Ave., New York.

International Association of Electrical Inspectors, Western Section—Toronto, Canada, Sept. 27-29. W. S. Boyd, 175 W. Jackson Blvd., Chicago.

American Electric Railway Association—Cleveland, Oct. 3-7. J. W. Welsh, 292 Madison Ave., New York.

Illuminating Engineering Society—Edgewater Beach Hotel, Chicago, Oct. 11-14. L. H. Graves, 29 West 39th St., New York City.

Eastern Association of Electrical Inspectors—Springfield, Mass., Oct. 12-13. E. P. Slack, 85 John St., New York.

Rocky Mountain Division, N.E.L.A.—Broadmoor Hotel, Colorado Springs, Col., Oct. 17-20. O. A. Weller, 900 15th St., Denver.

National Association of Railroad and Utilities Commissioners—Dallas, Tex., Oct. 18-21. James B. Walker, 270 Madison Ave., New York.

Public Utilities Association of West Virginia—Parkersburg, W. Va., Oct. 26-27. A. Bliss McCrum, 514 Charleston National Bank Bldg., Charleston, W. Va.

Enlargement of Jefferson City (Mo.) Plant.—McClellan & Junkersfeld, New York, are enlarging the Missouri Power & Light Company's plant at Jefferson City, Mo., by the installation of a 3,000-kw. turbo-generator, rebuilding the switchboard and making the necessary extensions to the building.

To Complete Municipal Plant at Gouverneur, N. Y.—Contract has been awarded by Gouverneur, N. Y., to complete the municipal hydro-electric plant on the Oswegatchie River. One of the three dams across the river has never been finished. Several cofferdams have been built above its site only to be torn out by high water.

Rucker Campaigns Against Indiana Commission.—Alvah J. Rucker, former city attorney of Indianapolis, who made sensational charges against utility companies and state officials at the time that the Indianapolis merger was consummated, is carrying on a campaign for the abolition of the Indiana Public Service Commission, his contention being that state officials are controlled by contributions in primary and election contests "from prospective office holders, crooked contractors on public works, but chiefly from operators of public utilities."

Central Illinois Public Service Power for Southeastern Missouri.—The Missouri General Utilities Company announces that it is serving its entire St. Genevieve division with power purcased from the Central Illinois Public Service Company. The Missouri company recently completed a 33,000-volt line over which this energy is transmitted. This line extends from St. Genevieve to Cape Girardeau, on the Mississippi, at which point cables have been laid across the river to connect with the Grand Tower generating station of the Central Illinois Public Service Company.

A.S.M.E. Power Program for Seattle Convention.—The American Society of Mechanical Engineers announces that several papers to be presented at the meeting of the society to be held in Seattle Aug. 29-31 will be of special interest to those interested in power developments in the Northwest territory. "Special Diesel-Engine Applications," by H. D. Estep, engineer, and Gerald Frink, president of the Washington Iron Works, will deal with Diesel drives for logging machinery, towboats and ferries. "The Pulp and Paper Industry of the Pacific Northwest," by C. C. Hockley, consulting engineer, Portland, Ore., will discuss the development and economic analysis of

the pulp and paper industry with a description of equipment and processes used. Following this study will be "Investigation of the Wood-Pulp Industry," by C. Konzo and B. W. Ross, members of the student branch of the University of Washington.

Pennsylvania-Ohio's Expansion Program.—In addition to the enlargement of its generating station at Toronto, Ohio, as previously reported, the Pennsylvania-Ohio Power & Light Company announces a five-million-dollar program of extensions in the Youngstown territory. Chief among the items is a substation to be erected west of Youngstown and known as Salt Springs station. This substation will have an initial capacity of 15,000 kw., which will later be increased to 28,000 kw. It will be connected with the Boardman substation by transmission lines 9 miles long carried on 100 steel towers.

Walla Walla River Hydro Plans Completed.—Plans for a new Walla Walla River hydro-electric development are rapidly nearing completion, according to Howard Evans of Freewater, Ore. The plans include a power station for the development of at least 4,000 hp. It is proposed to tap the tailrace of the Pacific Power & Light Company at the power house on the Walla Walla River and convey this water to the mouth of Couse Creek, where the power house of the Walla Walla River hydro-electric project will be constructed. Three reservoirs are to be built on Couse Creek for the storage of water sufficient to irrigate 25,000 acres of land.

Builds 12,000-Kw. Station in Less than Twelve Weeks.—The Pecos Valley Power & Light Company, organized on April 8 for the purpose of serving the oil fields in western Texas with electrical energy, has started up its 12,000-kw. generating station, which, operated under tests for three weeks without interruption, is now serving the company's customers. Ground for the plant was broken on April 25, and on July 15 the station was complete. G. I. Rhodes of Ford, Bacon & Davis, president of the Pecos Valley company, said that it has contracts in hand with oil companies controlling two-thirds of the producing acreage in the Pecos Valley district.

Proposed Selinsgrove Plant Again Arouses Notice.—From Sunbury, Pa., it is reported that preliminary work on the long-talked-of generating plant of the Pennsylvania Power & Light Company, scheduled to be erected at Hummelswharf, across the Susquehanna River from Sunbury, will probably soon begin. The company named has, it is said, recently acquired 60 ft. of ground in addition to the large tract already owned along the river for a right-of-way from Selinsgrove north to the site where the big plant is to be erected. The ground was purchased at the instance of the Pennsylvania Realty & Investment Company. More than 200 acres of land has been acquired by the company. The blue prints, maps and agreements were prepared in the engineering department of the Pennsylvania Railroad, which, it is understood, will sign as third party to the agreement for the right-of-way. Additional evidence that the Pennsylvania Power & Light Company will push its plans is seen in the fact that tenants occupying properties owned by the company have been notified to vacate within thirty days. The houses have been rented from month to month since the purchase of the ground. The Pennsylvania Railroad will, it is thought, endeavor to get in a spur line before the coming of winter.

"Getting Electricity from the Air."—Considerable interest was recently aroused in Kansas City, and, it is said, considerable money raised, by one H. E. Perrigo, who claimed to be able to run an automobile by means of electricity taken from the air. Demonstrations of his alleged discovery, with its "mystery box," were convincing to some until batteries were found to be concealed behind the cushions of the car. Perrigo, who obtained much newspaper publicity, maintained that the batteries were not essential and that he could operate his car without them; but faith in another epoch-making invention no longer is entertained by more than a very few of his former backers in the Missouri city, and criminal proceedings are likely to be taken against him.

Fitchburg, Mass., Improves Public Building Lighting.—A program to better the use of electricity in forty-seven public buildings in Fitchburg, Mass., is now in progress as the result of a survey recommended and approved by the Mayor and City Council. The work includes the removal of old lighting fixtures, the rewiring of twenty-seven school buildings and installation of new fixtures increasing the intensity of illumination from the present figure of 3 foot-candles to 7 foot-candles, the relighting and rewiring of police stations, fire-engine houses, library and hospital buildings, and the replacement of an old system of water motors driving ventilating fans by modern electric motor drive. The work is under the oversight of William J. Marlowe of Charles H. Tenney & Company, Boston, managers of the Fitchburg Gas & Electric Light Company.

Ultimate Capacity of Tacoma's Cushman Plant.—Issuance of state permits giving Tacoma, Wash., the right to appropriate 600 sec.-ft. of water from the South Fork of the Skokomish River in Mason County clears the way for that city to increase the ultimate power output of its Cushman project by approximately 100,000 hp. The present Cushman power plant is on the North Fork of the Skokomish River, about 6 miles above Hoodsport, just below the big Cushman Dam. It is proposed by the city's engineer to dam the South Fork at an elevation such that the water from this stream can flow through a tunnel bored between the two fork basins into the present reservoir. The present power plant at the base of the dam could be increased in size from 50,000 hp. to 85,000 hp., and in the second unit of the development, which contemplates the use of the water again at sea level, the increase in power would be more than 65,000 hp., it is estimated.

New Lines and Substations for San Antonio. — Construction of a second high-tension line by the Comal Power Company, subsidiary of the San Antonio Public Service Company, from its power plant at New Braunfels, Tex., to San Antonio is in progress. The two companies will jointly construct a receiving substation on McCollogh Avenue, San Antonio, and a distributing station near Cementville, in addition to the distributing station just completed on Callaghan Road. The cost of the new construction work will be approximately $300,000. The Callaghan Road station will serve a district with a radius of three to five miles, while the station to be built near Cementville will serve Alamo Heights, a rapidly growing suburb of San Antonio.

Utility Company Offers Low Rate for Lighting Nebraska's New Capitol.—The Lincoln Public Service Company has submitted a proposal to the Board of Control for the State of Nebraska by which it will agree to supply all electrical energy needed by the state institutions in Lincoln, including the new Capitol, now more than two-thirds completed, for 1½ cents per kilowatt-hour. The company will agree to supply any amount desired for as long a period of years as the state may wish to contract for. The proposal is made at this time because the state is contemplating the investment of $120,000 additional in a plant at the state penitentiary, 4 miles south of the Capitol, and must soon figure upon a sufficient supply to light the latter building when completed. O. J. Shaw, vice-president and general manager of the company, says its offer would save the state $26,000 a year in operating expenses and make unnecessary any further investments in state plant.

Hydro-Electric Improvements in New Hampshire.—Expansion of the hydro-electric plant on the Connecticut River between West Stewartstown, N. H., and Canaan, Vt., has been started by the Southern New Hampshire Hydro-Electric Corporation of Colebrook, N. H. The work includes construction of a wooden-pipe line, 1,400 ft. long. A power house will be built at the end of this pipe line, operating under a net head of 35 ft. and consisting of a waterwheel driving a 1,100-kw., 2,300-volt generator. A transmission line at 33,000 volts will be built between Canaan and Lancaster, N. H., to interconnect with a high-tension line of the Twin State Gas & Electric Company which extends from Gorham, N. H., to St. Johnsbury, Vt. In connection with the project the Twin States company will develop the station at Gorham, increasing the capacity 300 kw. The system being developed by the two companies will draw from three watersheds, the Androscoggin River at Gorham, the Passumpsic at St. Johnsbury and the Israel River at Lancaster.

Recent Court Decisions

Electric Company Has No Duty to Notify Customer's Family of Suspension of Service During Repairs. — In Stroup vs. Alabama Power Company suit was brought for damages because of the suspension of lighting service for about 40 minutes at 2 a.m. while plaintiff was undergoing medical or surgical treatment, such suspension inuring to her injury. The Supreme Court of Alabama has sustained the trial court in finding that the suspension of service was justified by the necessity for replacing a pole that had been blown down, that the work was done at the time of lightest load and in the most expeditious fashion possible, and that the company was under no obligation to notify the members of the family of a customer before shutting off the current. (113 So. 18.)*

Test of Constitutionality of New York Water-Power Act.—A decision in the long-extended case of Horton vs. Niagara, Lockport & Ontario Power Company has been handed down in the Supreme Court of New York which allows resumption of condemnation proceedings and determines the ownership of disputed property on the Salmon River near Altmar, N. Y. In the case just decided, one of a series, action was taken against the power company to determine title to property on the south bank of the river at a point where the power company is condemning lands. In the decision rendered it is held that the title of the plaintiffs is limited to the high-water mark and that the bank is the property of the power company. The litigation grew out of an application by the power company to the Public Service Commission as a test of the constitutionality of the Miller water-power act. The commission had refused to act. The Niagara, Lockport & Ontario is engaged in a hydro-electric development upon the Salmon River.

No Ground for Upsetting Sale of Fort Atkinson (Wis.) Municipal Plant. —In declaring valid the election at Fort Atkinson, Wis., which declared for the sale of the municipal electric and gas plants to the Wisconsin Gas & Electric Company (see ELECTRICAL WORLD for May 14, page 1033), the Wisconsin Supreme Court said (Wisconsin Gas & Electric Company vs. Fort Atkinson): "A persual of the record satisfied us that the merits of this controversy were fully and adequately presented to the electorate of the city of Fort Atkinson. No doubt things were said and done that might better have been left unsaid and undone, but on that score honors seem to be easy on both sides. There can be no doubt that the electorate fully understood the issues presented. Whether the inclusion of the surplusage in the publication of the final ballot and in the ballot presented to the electors helped the one side or the other it is difficult to say. Whatever was done was done openly, there was no concealment, there was but one issue, and that was whether or not the city should sell its electric and gas utilities for a cash price of $450,000. Upon the execution and delivery of the proper conveyances and payment of the purchase price, plaintiff will take a good and complete title to the property."

Commission's Right to Take Contempt Proceedings Upheld.—A special court of three federal judges at Los Angeles has issued an important decision upholding the powers granted to the Railroad Commission by the public utilities act of California to enforce its decisions by proceedings for contempt. This decision was issued in the case of B. G. Adams, who operates the Vermont Water Company in Los Angeles County, against the members of the commission. The court in its opinion states: "It is not for this or any other federal court to anticipate what punishment the State Railroad Commission will impose for the contempt of its order committed by the plaintiff Adams. On the contrary, the presumption clearly is that whatever punishment is so imposed will be in accordance with the provisions both of the laws and of the Constitution of the State of California."

Maryland Court on Public Ownership.—In reversing a lower court and sustaining the Public Service Commission of Maryland in its authorization of the city of Hagerstown to build an extension to its municipal plant (ELECTRICAL WORLD, July 16, page 130), the Court of Appeals of Maryland, in the course of a long opinion, said: "Whether the production and distribution of electric current for private use should be by municipal ownership or through private enterprise is a debatable governmental question whose proper solution is no function of the courts. So many divers elements enter into the relative merits of public or private ownership of such a public utility that the holding of one view or the other is but the expression of a judgment on a highly controversial subject. The fact that the city of Hagerstown holds the opinion that municipal production and distribution to private consumers is better for its interest and should be maintained is the expression of an opinion in a governmental matter that cannot be adjudged unreasonable on this record. . . . Against the evidence and fair inferences the testimony of the appellees was not sufficient to prevail on a question of unreasonableness. It may be economically unwise for electric current and power to be generated and sold by the municipality as the proprietor of a public service enterprise, but about this reasonable men may differ as is demonstrated by the fact that the commission in 1923 was unanimously of the opinion that the certificate of authority should not be granted and less than three years later, with a change of but one member, was a unit in granting the certificate of authority sought."

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

Delay in Rate Fixing Caused by Appraisal Proceedings Is Reasonable and Lawful.—The Ohio Public Utilities Commission, in directing the Ohio Bell Telephone Company to open its records for further investigations in a statewide telephone rate case, against the company's protest, declared that any delay occasioned because of the task of appraising the company's property for rate establishment is "not unreasonable or unlawful."

Rates for Water-Heating Service.—In establishing rates for the Truckee River Power Company the Nevada Public Service Commission held that low electric rates for water heating cannot be justified on the ground that this is an off-peak service and produces a favorable load, where the majority of the heaters are in service at all times and the company purchases its power. The fact that electric consumers have gone to great expense to enjoy low heating rates because of vigorous solicitations of such business may be considered, the commission said, in determining whether increased rates should be imposed. A non-compensatory rate for electric water heating is not, however, justified on the ground that such service is in an experimental stage. A lower demand charge may be made where there is a two-way switch on the line to a water heater and electric range than in cases where both of these appliances are directly connected.

State's Water-Power Interests Held to Outweigh Rights of Individual Enterprise.—Approval of the requisite corporate right to construct an electric transmission line through the eastern portions of Wayne and Pike Counties, Pennsylvania, along the Delaware River, has been denied by the Pennsylvania Public Service Commission on the ground that public necessity and convenience did not require such construction and that it might impair the development of water-power projects along the Upper Delaware. It was admitted by the applicant, the Scott Township Electric Company, that the main purpose of the application was to secure rights whereby a transmission line might be erected in Pennsylvania to connect New York and New Jersey group territories. The commission said that it had no desire to stand in the way of interconnection between electric development projects in neighboring states, and that were the transmission line route applied for the only one available or possible to the applicants, and if no other factors of importance bore upon the situation, it would not withhold its consent. But, the commission said, the rights of the public, as guarded by the state, in water-power developments must transcend the interests of any individual corporation or enterprise seeking other legal rights in the territory that was in question.

Men of the Industry

J. A. Ward in Ohio

J. A. Ward, vice-president and general manager of the Northwestern Public Service Company at Huron, S. D., since 1923, has been appointed vice-president and general manager of the Ohio Electric Power Company with headquarters at Sidney, Ohio, to succeed Elmer A. Shrider, who has assumed new duties in Chicago. **T. T. Parker**, formerly vice-president and general manager of the Kansas Electric Power Company, has been appointed vice-president and general manager of the Northwestern Public Service Company to succeed Mr. Ward, and **W. C. Blanchard**, division manager of the Northwestern Public Service Company at Aberdeen, S. D., has been selected to fill the vacancy resulting from the promotion of Mr. Parker.

William H. Maxwell, Jr., formerly representing a group of industrial and business publications, including McGraw-Hill periodicals, on financial advertising, has discontinued this work to become associated with Hallgarten & Company, bankers of New York.

Ezra B. Whitman, a member of the Maryland Public Service Commission since 1921, has resigned. A graduate of Cornell University, Mr. Whitman has engaged in private consulting practice along sanitary and hydraulic lines. He is a member of the firm of Norton, Bird & Whitman, engineers of Baltimore, Chicago and New York. Mr. Whitman will remain on the commission until several hearings shall have been concluded. **S. Purcell**, formerly chief engineer of Baltimore and now head of the Bureau of Highways, has been appointed to fill the vacancy caused by Mr. Whitman's resignation.

Theodore Beran, commercial vice-president of the General Electric Company, in charge of activities in the New York district, sailed on the *Leviathan* Aug. 20 for an extended pleasure trip through Europe. He plans to visit several countries and while in Italy expects to attend the exercises of the International Electrotechnical Commission in commemoration of the one hundredth anniversary of the death of Alessandro Volta.

F. E. Kruesi was appointed assistant to the president of the Middle West Utilities Company at a recent meeting of the company's board of directors. Mr. Kruesi received his education at Union College, Schenectady, and his preliminary training in things electrical with the General Electric Company. Following graduation from the University of Wisconsin in 1908, he spent two years in the construction and operating departments of the Commonwealth Edison Company. Subsequently he entered the employ of the Public Service Company of Northern Illinois as construction engineer at Streator, severing his connection with that utility at the end of two years to join the Illinois Northern Utilities Company as operating engineer at Dixon. In 1914 he became manager of the Freeport Railway & Light Company. During the six years following his discharge from military service he was a resident of Seattle, but removed his interests in 1926 to the Middle West Utilities Company.

John H. Mitchell, for the past twelve years manager of the East St. Louis Light & Power Company, East St. Louis, Ill., has been appointed general manager of the Southern Illinois group of the Illinois Power & Light Corporation. Mr. Mitchell first became identified with the public utility field in 1903, when he affiliated himself with the Indianola Light, Heat & Power Company of Columbus, Ohio. He joined the East St. Louis Light & Power Company in 1915 as new-business manager, and after being discharged from military service he organized the sales department, subsequently being appointed general manager of the company. Mr. Mitchell has been active in association work, only recently completing a term as president of the Illinois State Electric Association.

George P. May, who has been connected with the East St. Louis Light & Power Company since 1914, has been appointed general manager of that utility to suceed John H. Mitchell, resigned. Mr. May has been connected with public utility companies for the past sixteen years, having received his B. S. degree in electrical engineering at the Kansas State Agricultural College, class of 1911. He spent three years with the Kansas City Power & Light Company before affiliating himself with the East St. Louis Light & Power Company. During his thirteen years of service he has filled a number of positions, ranging from assistant superintendent of the meter department to electrical engineer, the position he occupied until his recent promotion.

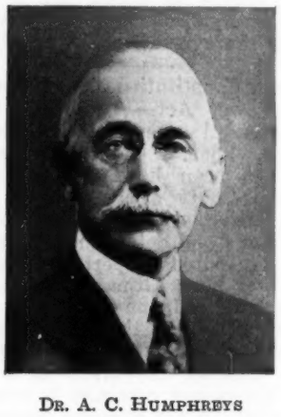
C. H. Kretz has been elected vice-president of the Public Service Company of Oklahoma, which recently acquired the properties of the Oklahoma Power Company and now furnishes electric service to most of northeastern and southeastern Oklahoma. Mr. Kretz was formerly vice-president and general manager of the Oklahoma Power Company.

Obituary

Prof. Bertram B. Boltwood, scientist and discoverer of ionium radioactivity, committed suicide Aug. 14 at Hancock Point, Me. Despondency over ill health was assigned as the cause. Professor Boltwood, who was born 57 years ago in Amherst, Mass., was prominent in all work in chemistry at Yale and was one of the chief designers of the Sterling Chemistry Laboratory. He first joined the faculty at Yale in 1891 and occupied the chair of radio chemistry at the university for seventeen years.

Dr. A. C. Humphreys

Dr. Alexander C. Humphreys, well-known educator and engineer, died Aug. 14 at his home in Morristown, N. J., as the result of a general breakdown. He was 76 years of age. Dr. Humphreys' death brought to a close an exceptionally useful and varied career during which he devoted himself not only to educational and engineering activities but also to the world of art and to public affairs in general. He was president of the Stevens Institute of Technology, Hoboken, N. J., from 1902 until last June, when his resignation from that academic post, tendered the preceding fall, became effective. In the course of his connection with the public utility field he had served as chief executive of more than 50 gas and electric lighting companies, in addition to holding office and membership in the representative associations of both the gas and the electrical industry. He wrote extensively



DR. A. C. HUMPHREYS

on engineering subjects, having been the author of numerous papers on engineering education, engineering depreciation, accountancy, appraisals and similar subjects. He found time to gather an extensive collection of American paintings and through his London connections exerted every effort to attract the attention of Europe to the work of American artists.

Dr. Humphreys was born in Edinburgh, Scotland, but removed to America at an early age. His first business connections were with insurance companies in Boston and New York, but subsequently he entered the public utility field. Connections with the Bayonne & Greenville Gas Light Company, the Pintsch Lighting Company of New York, the United Gas Improvement Company and the firm of Humphreys & Glasgow, engineers, London and New York, followed. In the meantime he had become a student at Stevens and was graduated in 1881. He became the institute's second president in 1902. Dr. Humphreys was a former president of the American Society of Mechanical Engineers, the American Institute of Consulting Engineers and the American Gas Institute and was a member of the American Institute of Electrical Engineers, the United Engineering Society, the Society for the Promotion of Engineering Education, the American and also the British Association for the Advancement of Science and many other technical organizations.

Financial and Statistical

Prices on Exchange Recover
Utility Market Sound
Bond Issues Show Vigor

PRICES on the New York Stock Exchange early this week showed a marked recovery, following the violent decline on Thursday and Friday of last week, resulting from the break on Thursday in the shares of the Manhattan Electrical Supply Company, which sold down to 58¼ from 121. Even leaders such as United States Steel common, General Electric, General Motors and similar issues broke badly as selling orders poured in from all sections of the country. On Saturday an improvement was perceptible, and during the week the recovery has continued.

The utility market, though not especially active, is fundamentally sound. During the week under review the New England Power Association reached a new high, 94, advancing from a low of 49¾ for the year. Brooklyn Edison reported an advance of seven points over last week, and Mohawk-Hudson, American Gas & Electric and Edison Electric Illuminating of Boston also showed strength. Utility preferred shares remained quiet. The bond market was considerably stronger. Call money declined to 3½ per cent.

Canadian Output of Energy Up 13 Per Cent in Year

According to recent statistics, the daily production of electrical energy throughout the Dominion of Canada during March, April and May, 1927, was 13 per cent greater than during the same period in 1926. The corresponding increase in Ontario and Quebec amounted to 14 per cent. The daily energy production for each month during the last four years has shown a marked increase over the production in the corresponding month of the previous year; therefore, rate of increase rather than absolute volume of production is the significant index of improvement. The improvement shown during 1926 as compared with 1925 was much greater than that shown in 1927 as compared with 1926.

DAILY PRODUCTION OF ELECTRICAL ENERGY FOR CANADA

	Thousands of Kilowatt-Hours				
	1923	1924	1925	1926	1927
Jan.	19,079	21,120	23,198	27,676	31,621
Feb.	19,492	21,384	23,160	28,880	31,941
March	19,305	20,747	22,452	27,711	31,345
April	18,860	21,079	22,482	26,979	30,836
May	19,557	20,824	22,297	26,952	31,132
June	19,049	19,779	21,470	27,999	
July	18,452	19,475	21,470	27,000	
Aug.	19,356	19,868	21,485	27,723	
Sept.	19,956	20,958	23,992	29,360	
Oct.	20,785	21,209	24,400	30,040	
Nov.	21,273	22,606	25,625	30,672	
Dec.	20,461	23,479	26,573	31,381	

Commenting on this condition, a statement of the Royal Bank of Canada points out that the marked improvement shown during 1926 occurred at the time when a corresponding improvement was taking place in the volume of manufacturing activity. Between 1925 and 1926 there was an increase of 350,000 tons in newsprint production in Canada. Newsprint production requires a large amount of power. During the first half of 1927 there has also been a marked increase in newsprint production, and there are a number of newsprint mills which will begin operations during the second half of 1927 and the early part of 1928, so that this one factor should have a marked influence upon statistics of electrical energy. A further factor which will make for increased use of energy during 1928 will be the electrochemical manufacturing of the Aluminum Company of Canada.

The figures compiled by the bank are given in the accompanying table.

Massachusetts Premium Law Criticised

It Is Urged that the Proposed Capitalization of Premiums Would Widen Market for Shares of Utility Stock

By Prof. W. M. Daniels
Department of Transportation, Yale University

Massachusetts public utility legislation differs in certain important respects from that of most of the other states. The premium law, against which a bill was brought forward recently, is one of the outstanding points of difference. Mr. Daniels, in a brief filed recently before the Department of Public Utilities, outlines certain economic disadvantages of the premium law. His conclusions are here presented.

I ASSUME that the question to be covered in this memorandum is not the basic rule for rate making or the fundamental basis upon which the return permitted under contested rates is to be tested. It is rather the question whether the modifications suggested in the present statute have a sound economic warrant.

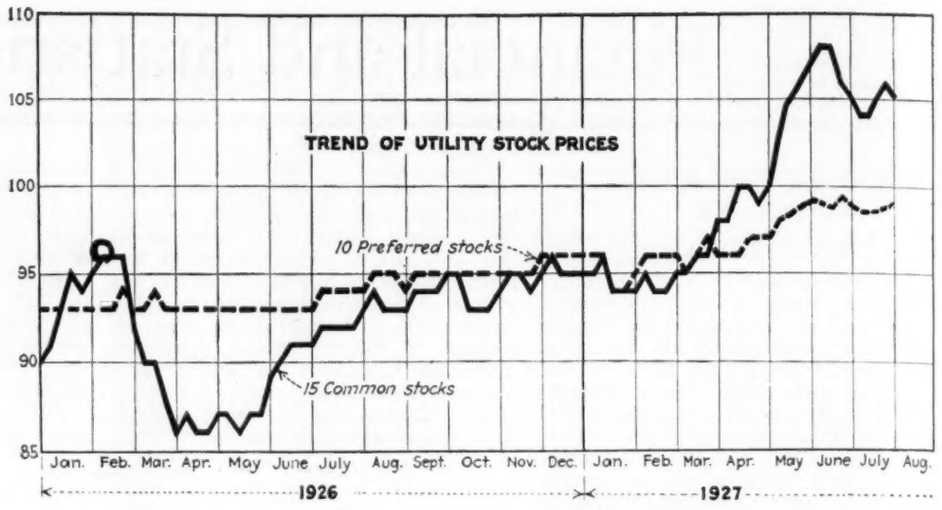
The changes are essentially two in number—first, that gas and electric companies may capitalize the difference between the total amount paid in on stock issued at a premium and the face value of shares actually issued at their par value to the shareholders of record when the department issues its permit, provided the department by an audit assures itself that the outstanding stock, the premiums paid in and the debt are not in excess of the fair value of the company's land and structures; second, that subsequent stock issues may be made to shareholders of record upon their payment therefor in cash at par.

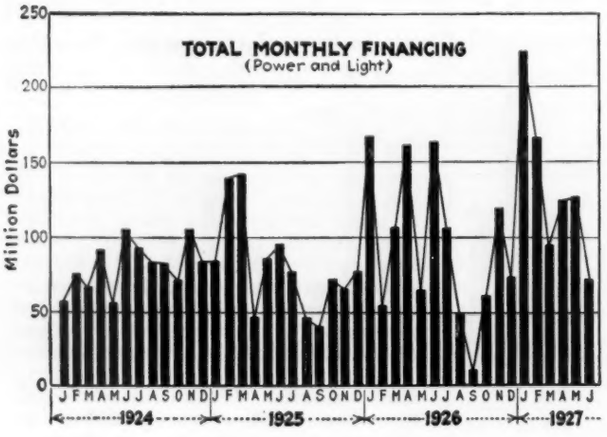
The first advantage that appears in the proposed change would be the widening of the market for the shares of utility stock. The capitalization of premiums would operate to lower the market value of the shares and would tend to surmount the prejudice entertained by many investors to stock commanding a high market premium. It would similarly bring within the means of small investors the stock of utility companies and tend to make for a wider local distribution thereof. It would assimilate the stocks of Massachusetts utilities to those of corporations of foreign origin which, partly by reason of the absence of a premium, appear more attractive to local investors in Massachusetts. When it is considered that these utilities are growing at an unprecedented rate, the assurance of an adequate supply of new capital to the public service companies would appear to be of prime importance to the public good.

A second advantage that would be realized would be the possibility of lessening substantially the disparity between the rate of dividend now not uncommon and the real rate of return upon the actual present value of the property which these corporations are using in the service of the public.

A third economic advantage would ensue from the elimination of the fixing of the issue price set upon new issues of utility shares. The problem now devolves in the first instance upon the corporation, with a veto power in the department, which may replace the directorate's proposed issue price by another if it deems the company's price "so low as to be inconsistent with the public interest." This has been interpreted to mean that the company's proposed issue price may be displaced if "materially lower than will assure a ready market for the issue." (216 Mass. 432.) The intrinsic difficulty of setting the price has been attested upon various occasions. It may readily prove an impossible task for either the company or the department, particularly when no reliable and available record of the market sales of such shares is available. When the desideratum is a given amount of new money and can be obtained by sale at par to

Monthly Indexes of Business Trends *in the* ELECTRICAL INDUSTRY




TOTAL MONTHLY FINANCING
(Power and Light)
Million Dollars
250
200
150
100
50
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1924
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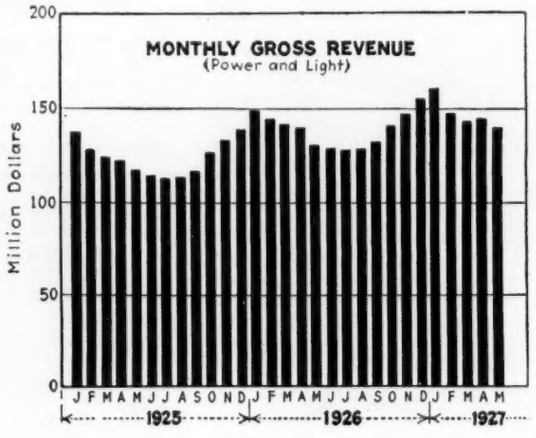
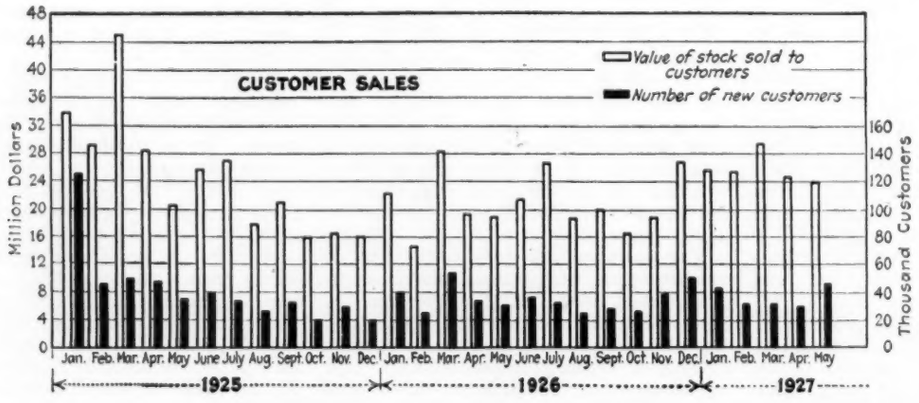
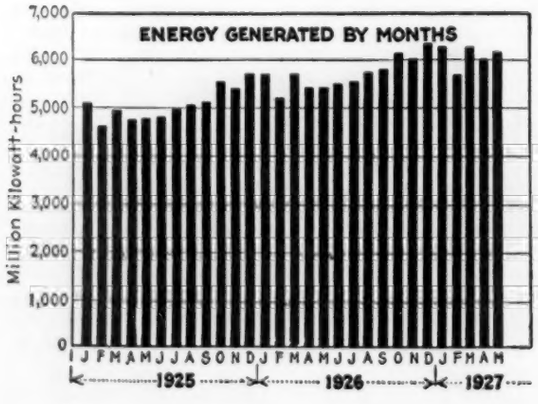
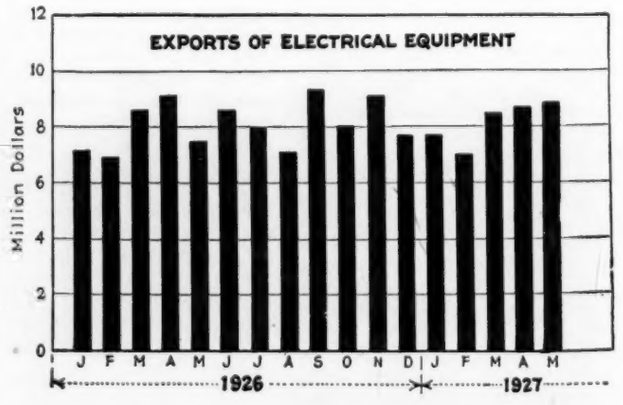








stockholders of record, it would seem that the present intricate plan of price fixing might advantageously be discarded.

Fourth, another persuasive reason for the proposed changes is to be found in the danger that enforced sales at a premium constituting the lowest price compatible with the public interest will estop the department from attempting to lower unreasonable rates where such rates are found to be necessary to sustain the market price of the shares at or near the authorized issue price. The department has itself said in its report in January, 1922:

"As market value was made expressly the test of the issue price of new shares under the 1894 law, to the extent to which such market value reflected earning power, the effect of the law was to capitalize as against the consuming public the existing earning power of a company at the time of a new issue, regardless of whether that earning power was based on reasonable or excessive rates or charges."

When the rate of capitalization of expected dividends falls, the market price of shares will be correspondingly raised, to the further detriment of the consuming public.

As the department has itself said in the same report (page 33):

"Thus the very law requiring stock to be sold at a premium may tend to impair substantially the power of the state to regulate rates. It also may result in giving a fictitious value to the stock already issued, and thus require a larger amount of money from the consumers than is a fair return upon the fair value of the property employed for the public benefit, in order to raise the sums needed to provide dividends of the amount paid at the time of the increase in the stock, to meet fixed charges and to make proper provisions for depreciation."

Only a word need be added as regards the allegation that a capitalization of premiums would benefit the shareholders of record when this capitalization is allowed and would operate unfairly as between those who actually paid the premiums into the corporate treasury and those who perhaps acquired their holdings at a later time and at lower prices. The answer is that to repair this inequality, if such it be, is now impossible. The shareholders of record have succeeded to the rights and the obligations of prior holders. The proposed changes would, however, operate to lessen the recurrence of a similar situation in future.

I assume that it is not necessary to discuss the point that the capitalization of premiums might make readily marketable the "rights" of those to whom shares would be issued which would command a market price above par. These "rights" are not created by the capitalization of premiums. They already exist, so far as their value is concerned, in the present shareholder's equity in the assets and earning power of the company. They could be realized as well by the sale of present shares as by disposing of the additional shares issued under the proposed change in the law.

Public Service Corporation to Issue Preferred Stock

Directors of the Public Service Corporation of New Jersey have authorized the issuance of at least 171,566 additional shares of 6 per cent cumulative preferred stock of $100 par value, preliminary to the popular ownership campaign which the corporation is planning to undertake starting Oct. 1. Holders of outstanding 8 per cent, 7 per cent

Stock Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Aug. 16	Low 1927	High 1927
ABITIBI PWR. & PAPER, 4% com.—no par	102¼	83	104¼
Adirondack Pwr. & Lt.—7% pf.	112¾	107	113½
Adirondack Pwr. & Lt.—8% pf.	115	112	116
Ala. Pwr., $7 cum. pf.—no par	111	107	112¼
Allis-Chalmers Mfg., 7% pf.	m111¼	109	112¼
Allis-Chalmers Mfg., 6% com.	106¼	88	111¼
Aluminum Co. of Amer., com.	90¼	67½	105
Aluminum Co. of Amer., 6% of	104	101½	104¼
Amer. & Foreign Pwr., pf. 25% pd.	m110	....	....
Amer. & Foreign Pwr., 7% pf.—no par	100¼	86¼	102
Amer. & Foreign Pwr., com.—no par.	23½	18¾	25½
Amer. Bosch Magneto, com.—no par	21	13	22½
Amer. Brown Boveri Elec†	k 12	10½	39½
Amer. Brown Boveri Elec., pf. $7	47½	47½	98
Amer. Gas & Elec., 6% pf.—no par	101¼	95½	101½
Amer. Gas & Elec., com.†—no par	95¼	68¾	100½
Amer. Lt. & Trac., 6% pf.	115	108	133
Amer. Lt. & Trac., new com.	169	164¼	178½
Amer. Pwr. & Lt., 6% pf.	104½	97½	106½
Amer. Pwr. & Lt., com.†—no par	60¼	54	67
Amer. Pub. Serv., 7% pf.	a 99½	94	104
Amer. Pub. Serv., com.†	75	45	100
Amer. Pub. Utilities, 7% ptc. pf	a87½	73	88½
Amer. Pub. Utilities, 7% pr. pf.	a 94	92	96
Amer. Pub. Utilities, com.	55	65	70
Amer. States Sec., A	2½	2½	4½
Amer. States Sec., B	3½	2½	4½
Amer. Superpwr., 6% ptc pf.—25	29	26½	29½
Amer. Superpwr., 6% 1st pf.	k 97½	....	....
Amer. Superpwr., Class A†—no par	34¼	27½	38½
Amer. Superpwr., Class B†—no par	35½	28½	39½
Amer. Wtr. Wks. & Elec., 7% pf.	k111½	104¼	111½
Amer. W. W. & E., com. $1.60—20	101	62½	101
Anaconda Copper cap. $3	46¼	41½	49¼
AppalachianElectric Pwr., 7% pf.	102½	98	103½
Appalachian Elec. Pwr., com.	78	77	83
Arizona Pwr., 7% pf.	k 76	77	84½
Arizona Pwr., com.	m 20	....	....
Arkansas Pwr., & Lt. 7% pf.	103½	....	....
Assoc. Gas & Elec., $3.50—50	51½	....	....
Assoc. Gas & Elec., pf.—36—no par	93	85	93
Assoc. G. & E., Class A, 10—no par	41½	35	43
BABCOCK & WILCOX, 7% com.	116	113	124
Binghamton L., H. & P., $6 pf.	98	94	100
Birmingham Elec., pf.—$7—no par	107½	105	109
Blackstone Valley G. & E., 6% pf.	101½	100	106
Blackstone Valley Gas & Elec., 10% com.—50	139	98	154½
Blaw-K nox, com.†	f 75	....	....
Brazilian Trac., Lt. & pwr., com.†	f171	....	....
Broad River Pwr., 7% pf.	101	97	103
Brooklyn Edison, 8% com.	184½	148½	184½
Buffalo, Niagara & East. Pwr., $1.60 pf.—25	f 25½	....	....
Buffalo, Niagara & East. Pwr. com. $1—no par	f 34½	....	....
CALIFORNIA ELEC. GENERATING, 6% pf.	96½	92	99
California Ry. & Pwr., 7% pf.	130	98	150
Carolina Pwr. & Lt., pf.—$7—no par	f109	107	109
Central & S.W. Util., $7 pf.—no par	a 96	93½	97½
Central & S.W. Util., pr.in.$7 pf.—no par	a102½	98½	104½
Central Ariz. Lt. & Pwr., 8% pf.	k 97	95	98
Central Ark. Ry. & Lt., 7% pf.	106	100	104
Central Ill. Pub. Serv., $6 pf.	e91½	88½	95½
Central Ind. Pwr., 7% pf.	93	84	95
Central Pwr. & Lt., 7% pf.	101	100½	103
Central States Elec., 7% pf.	96	93	96
Central States Elec., com.†	m200	....	....
Century Elec., 6% com.	m115	115	115
Chicago Fuse Mfg., com.—$2.50 no par	a 33½	30	35
Cincinnati Gas & Elec., 5% com.	g 99	96½	100
Cities Service, $6 pf—no par	f 88½	87½	90½
Cities Service, pf. B—no par	k 8½	7½	♦8½
Cities Service, pf. BB—no par	m 82½	81	85½
Cities Service, com.—20	f 48	40½	58½
Cities Service, Bks. Shrs.—10	k 23½	22½	29½
Clarion River Pwr., 8% pf.	95	....	....
Cleveland Elec. Illg., 6% pf.	110½	108	112
Cleveland Elec. Illg., 10% com.	320	285	330
Columbia Gas & Elec., 6% pf.	105½	99½	107½
Columbia G. & E. com. $5—no par	95½	82½	98½
Columbia Ry., Gas & Elec., 6% pf.	m 98	97	100
Columbus Elec. & Pwr., $2 com.—no par	70	....	....
Columbus Ry., Pwr. & Lt., 6% 1st pf.	102½	98½	102½
Columbus Ry., Pwr. & Lt., 6½% pf. B	101	96	103½
Columbus Ry., P. & L., com.—no par	100	75	105
Commonwealth Edison, 8% com.	a152½	138	155
Commonwealth Pwr., 6% pf.	100	91½	100
Commonw'th Pwr., $2, com.—no par	56½	48½	67½
Conn. Lt. & Pwr., 8% pf.	121	119	123
Conn. Lt. & Pwr., 7% pf.	117	112	118
Cons. Gas of N. Y., pf.	98½	93	99
Cons. Gas of N. Y., com. $5—no par.	113½	94	114½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6% pf.	k105	105	107
Cons. Gas, Elec. Lt. & Pwr. of Balti., 6½% pf.	e113	110½	113
Cons. Gas, Elec. Lt. & Pwr. of Balti., 7% pf.	e116½	112½	116½
Cons. Gas, Elec. Lt. & Pwr. of Balti., 8% pf.	e129	127	129½
Cons. Gas, Elec. Lt. & Pwr. of Balti., com. $2.50—no par.	e 59½	51	62
Consolidated Pwr. & Lt., 7% pf.	k105	100	106
Consumers Pwr., 6% pf.	102½	100	102
Consumers Pwr., 6.6% pf.	105	103	105½
Continental Gas & Elec., 8% ptc. pf.	106	103	106½
Continental Gas & Elec., 7% pr. pf.	105½	100	103
Conti. G. & E. com. $4.40—no par.	200	210	225
Crocker Wheeler, com.†	25	30	38
Crocker Wheeler, 7% pf.	82	78	88
DALLAS PWR. & LT., 7% pf.	109½	107	110½
Dayton Pwr. & Lt., 6% pf.	k106	101	107
Detroit Edison, 8% com.	151½	133½	157
Dubilier Condenser, com.—no par.	m 3½	3½	5½
Duquesne Lt., 7% pf.	116½	114½	116½
EASTERN NEW YORK UTIL., $7 pf.	105	103	107
Eastern New York Util. com.	65	60	70
Eastern States Pwr., $7, com.	9	9	13
Eastern States Pwr., pf.	90	90	95
East. Tex. Elec., 7% pf.	107	106	108
Edison Elec. of Boston, $12 com.	d245½	217	267
El Paso Elec., 7% pf.	108	105	107½
Elec. Bond & Share, 6% pf.	f109½	105½	109½
Elec. Bd. & Sh. Sec., com. $1—no par	f 73	67½	79½
Electric Household Util.†	a 12	11	15½
Elec. Investors, 6% pf.—no par	96	92	96
Elec. Investors, com.†—no par.	36½	32½	40½
Elec. Investors, 10% pd. receipts	m 15	....	....
Elec. Pwr. & Lt., ctfs. pf.	104½	96	106½
Elec. Pwr. & Lt., ctfs., 40% pd.	k114½	103½	115
Elec. Pwr. & Lt., ctfs. full pd.	m114	108½	111½
Elec. Pwr. & Lt., ctfs., com.—no par.	22½	16½	23½
Elec. Refrig. cap.†	17	12½	37½
Elec. Ry. Securities, com.—no par	6½	....	....
Elec. St. Battery com. $5.25—no par	71½	63½	79½
Elmira Wtr., Lt. & R.R., 7% pf.	102	98	103
Emerson Elec., pf.	m109	107½	111
Empire Pwr., pfc.†	36½	26	39
Engr. Pub. Serv., $7 pf.—no par	m104½	93½	106½
Engr. Pub. Serv., com.—no par	32	21½	32
Eureka Vacuum Cleaner, com. $4—no par	69	50	77
FAIRBANKS MORSE, 7% pf.	k108	107½	112
F.-M., com.—$3—no par	k 38	37½	43½
Federal Lt. & Trac., com. $1.40	42½	37½	47
Federal Lt. & Trac., $6 pf.—no par	97	91½	99½
Ft. Worth Pwr. & Lt., 7% pf.	f111	108	112
GALVESTON-HOUSTON ELEC. 6% pf.	70	68	72
Galveston-Houston Elec., com.	26	28	32
Gen. Elec., $3 com.—no par	124½	81	131
Gen. Elec., special—6%	11½	11	11½
Gen. Gas & Elec. (Del.) com. A. $1.50—no par	39½	34	47½
Gen. G.&E. (Del.) com. B—no par	m 44½	35½	44½
Gen. G.&E. (Del.) pf. A. $8—no par.	k116	113½	120
Gen. G.&E. (Del.) pf. A $7—no par	k108½	100	109½
Gen G.& E. (Del.) pf. B $7	k102½	96	105
Gen. Pub. Serv., $7 cum. pf., no par.	k107	102	106
Gen. Pub. Serv., com., no par	13½	11½	15½
Ga. Lt., Pwr. & Rys., 6% pf.	93	82	96
Ga. Lt., Pwr., & Rys., com.	50	50	80
Ga. Ry. & Pwr., 8% pf.	k123	119	125
Ga. Ry. & Pwr., 7% pf.	k113½	106	110
Gt. Western Pwr., 7% pf.	k103	....	....
IDAHO PWR., 7% pf.	106	103	109
Ill. No. Utilities, 6% pf.	k 88	88	92
Ill. Pwr. & Lt., 7% pf.	101½	99	101½
Ingersoll Rand com. $8	90	88½	96½
Int. Combus. Engr., com. $2—no par	49½	43½	64
Int. Util., Class A—$3.50—no par	40½	28	41½
Int. Utilities, Class B—no par	5½	3	7½
Interstate Pwr., pf.—$7—no par.	94	93	98
Interstate Pub. Serv., 7% pf.	99½	97	101
Iowa Ry. & Lt., 7% pf.	98	95	100
JERSEY CENTRAL PWR. & LT. CO., 7% pf.	102½	97½	102½
Johns-Manville, com.†—no par	95½	55½	98

Stock Exchange: aChicago; bSt. Louis; ePhiladelphia; dBoston; eBaltimore; fMontreal; gCincinnati; hSan Francisco; iPittsburgh; jWashington. kBid price Saturday, Aug. 13. lBid price Wednesday, Aug. 17. mLatest quotations available. †Dividend rate variable.

Stock Quotations of Electric Light and Power and Manufacturing Companies (Continued)

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stock is $100.)

Companies	Bid Price Tuesday Aug. 16	Low 1927	High 1927
KANSAS CITY PWR. & LT. pf.	*m*114	112	115¼
Kansas Gas & Elec., 7% pf.	*l*105½	103	107
Kentucky Hydro-Elec., 7% pf.	*a* 98	94½	98½
Kentucky Sec., 6% pf.	86	83	87
Kentucky Sec., 5% com.	109	110	115
Kentucky Utilities, 6% pf.	98½	93	100
Keystone Pwr. & Lt., pf.	98	95	100
LACLEDE GAS LT., 12% com.	*k* 235	173½	267½
Lehigh Pwr. Sec., com.—no par.	17½	15	20
Long Island Ltg., 7% pf.	109	107½	112
Long Island Ltg., com.†—no par.	144	140	150
Los Angeles Gas & Elec., 6% pf.	*k*102	98	104½
Louisville Gas & Elec., cl. A. $1.75	27½	23½	27½
MAN. ELEC. SUPPLY, cap. $5—no par	58½	50½	132
Manila Elec., com.†—no par.	50	40	50
Maytag Mfg., com. .50—no par.	33½	23½	34½
Memphis P. & L., pf.—$7—no par	109	105	110
Metropolitan Ed., pf.—$6—no par.	99½	93	100
Metropolitan Ed., pf.—$7—no par.	108	104	108
Metropolitan Ed., com. $5—no par.	70	....	....
Middle West Utilities, 7% pf.	*a*110½	105½	113½
Middle West Util., 8% pr. lien	*a*121½	117½	122½
Middle West Util., com. $6—no par ex. div.	*a*110½	108	117½
Midland Utilities, pr. in. 7% pf.	*a*105	92½	106
Midland Utilities, 6% pf. A	*a*102	92½	102
Milwaukee Elec. Ry. & Lt., 7% pf.	*k*102	100	103
Milwaukee Elec. Ry. & Lt., 6% pf.	*k* 98½	98	101½
Minn. Pwr. & Lt., 7% pf.	*l*105½	104	107
Miss. Pwr. & Lt., $8 pf.	*m*101	106	103
Miss. River Pwr., 6% pf.	102	94	103
Miss. River Pwr. 3% com.	62	....	....
Mohawk Hudson Pwr., 1st pf.—$7—no par	105	100	109
Mohawk Hudson Pwr., 2d pf.—$7—no par	*k*110	98	112
Mohawk Hudson Pwr., com.—no par	32½	20½	32½
Montana Pwr., 7% pf.	*m*106½	118½	106½
Montana Pwr., 5% com.	103½	81½	106½
Montreal Pwr., 7½% com.	*f* 89	....	....
Mountain States Pwr., 7% pf.	100	97	101
Mountain States pwr., com.†	18	....	....
NASSAU & SUFFOLK LTG., 7% pf.	107	98	105
National Carbon, 8% pf.	*m*139½	130½	139½
National Elec. Pwr., A†	24½	23½	25½
National Lt., Ht. & Pwr., com.	24	22	27
National, Light, Ht. & Pwr., 5% pf.	72	70	74
National Pwr. & Lt., pf.—$7—no par	107½	101	108½
National Pwr. & Lt., com.†—no par.	21½	19½	23½
National Pub. Serv., 7% pf.	97	93	100
National Pub. Serv., 7% ptc., pf.	113	108	115
National Pub. Serv., A com. $1.60—no par	21½	18½	24
National Pub. Serv., B com.—no par	*k* 18½	14	20½
Nebraska Pwr., 7% pf.	*l*109	106	109
Nevada-Calif. Elec., com.	*k* 27	25	31
New Brunswick Pwr., 4% pf.	62	50	65
New Eng. Pub. Serv., pr. in. pf. $7..	102	96	103
New Eng. Pub. Serv., pf. $7.	97	88	99
New Orleans Pub. Serv.—7% pf.	104	103	105½
N. Y. & Queens Elec. Lt. & Pwr., 5% pf.	90	91	97
N. Y. Central Elec., 7% pf.	101	98	102½
Newport News & Hampton Ry., Gas & Elec., 5% com.	109	....	....
Newport News & Hampton Ry., Gas & Elec., 7% pf.	109	....	....
Niagara Falls Pwr., 7% pf.—25.	*k* 28½	27½	29½
Niagara, Lock. & Ont. Pwr., 7% pf.	109	105	112
No. Amer., 6% pf.—50.	*k* 52	50	55
No. Amer., com.—10	49½	45½	52½
No. Amer. Edison, $6 pf.—no par.	101½	96½	102½
No. Caro. Pub. Serv., pf.—$7—no par	*k*101	93	102½
Northeastern Pwr., com.	18	14½	20½
No. N. Y. Utilities, 7% pf.	105½	103	109
No. Ohio Pwr., com.—no par.	12	9½	13½
No. Ohio Trac. & Lt., 6% pf.	80	75	83
No. Ohio Pwr. & Lt., 7% pf.	92	90	95
No. Ont. Lt. & Pwr., 6% pf.	*k* 91	84	95
No. Ont. Lt. & Pwr., 4% com.	*k* 72	73	78
No. States Pwr., (Del.) 7% pf.	104½	100½	107
No. States Pwr., (Del.) 8% com.	122	109½	124
No. Texas Elec., 6% pf.	62	65	70
No. Texas Elec., com.	22	27	36
OHIO BRASS, com. B $4—no par.	73	72	78
Ohio Brass, 6% pf.	101	100	104
Ohio Pwr., 6% pf.	101	97	103
Ohio Pub. Serv., $6 pf.	98	95	100
Ohio Pub. Serv., 7% pf.	105½	103	109
Ohio River Edison, 7% pf.	108½	103	109½
Oklahoma Gas & Elec., 7% pf.	101	....	....
PACIFIC GAS & ELEC., 6% pf.	26½	24½	26½
Pacific Gas & Elec., 8% new com.	38	31	39½
Pacific Pwr. & Lt., 7% pf.	*l*104	102	104
Penn Cent. Lt. & Pwr., $5 pf.—no par	*c* 76	76½	77
Penn-Ohio Edison, 7% pf.	102½	97½	104½
Penn-Ohio Elec., 7% pf.	*m*101½	98	100
Penn-Ohio Pwr. & Lt., 7% pf.	*l*105½	99	103
Penn Pwr. & Lt.—$7—no par.	*l*109	107	109
Penn Wtr. & Pwr., 8% com., new	*c* 57	47½	58½
Phila. Co., 6% pf.—50.	*c* 52½	49½	52½
Phila. Co., com.—50.	*k* 100	85½	110
Phila. Elec., 8% com.—25.	*c* 51½	46½	54
Portland Elec. Pwr., 7% pf.	99	97½	101
Portland Elec. Pwr., 6% pf.	79	78	83
Portland Elec. Pwr., 6% 2d pf.	58	55	70
Portland Elec. Pwr., com.	28	22	30
Potomac Elec. Pwr., 6% pf.	*j*108	....	....
Pwr. Corp. of N. Y., com. $1—no par	*m* 79	....	....
Pwr. Sec., pf.—no par.	*k* 28	28	33
Pwr. Sec., com.—no par.	*k* 6	5	8
Public Serv. of Colorado, 7% pf.	*l*102	....	....
Pub. Serv. of N. J., 6% pf.	*k*100½	98½	101½
Pub. Serv. of N. J., 8% pf.	*k*131	125	132
P. S. of N. J., $2 com.—no par.	42½	32	45½
Pub. Serv. of No. Ill., 6% pf.	*a*105	101½	106
Pub. Serv. of No. Ill., 7% pf.	*a*116½	112½	117
P. S. of No. Ill., com. $8—no par	*m*139	130½	143
Pub. Serv. of No. Ill., $8 com.	*a*140	132	142
Pub. Serv. of Okla., 7% pr. in.	101	97	102
Pub. Serv. Elec. & Gas, 6% pf.	*k*108	102	108½
Puget Sound Pwr. & Lt., 7% pr. pf.	106½	105	107
Puget Sound Pwr. & Lt., $6 pf.—no par.	88	83½	89
Puget Sound Pwr. & Lt., com.	32½	28	35½
RADIO CORP. OF AMER., $3.50 pf.—50.	52½	49	53
Radio Corp. of Amer., com.—no par.	67½	41½	67½
Republic Ry. & Lt., pf.	*m*120	....	....
Republic Ry. & Lt., com.	*m*135	112	135
Rochester Gas & Elec., 6% pf. D	*k*104½	101	103½
Rochester Gas & Elec., 7% pf. B	103	105	107
Rochester Gas & Elec., 6% pf. C.	*k*104½	101½	103½
SAFETY CABLE, com. $4.	70	52½	74½
San Joaquin Lt. & Pwr., 7% pr. pf.	99	96	101
St. Joseph Ry., L., H. & P., 5% pf.	72	65	75
Servel Corp.	*k* 1½	1	10½
Sierra Pacific Elec., 2% com.	24½	24½	28½
Sioux City Gas & Elec., 7% pf.	102	99	104
Southeastern Pwr. & Lt., pf.—$7 no par	*l*105½	....	....
Southeastern Pwr. & Lt., ptc. pf.	*l* 79½	....	....
Southeastern Pwr. & Lt., com.—no par.	37½	29½	38½
So. Calif. Edison, 8% pf.	39½	35	41
So. Calif. Edison, 7% pf.	*k* 28½	27½	28½
So. Calif. Edison, 6% pf.	*k* 26	24½	27
So. Calif. Edison, 8% com.	36½	31½	36½
Southern Cities Utilities, 7% pf.	70	67	90½
Southern Cities Utilities, com. $4.	31½	22½	42½
Southwestern Lt. & Pwr., A $3.	63	60	65
Southwestern Lt. & Pwr., $6 pf.	89	83	91½
Southwestern Pwr. & Lt., 7% pf.	108	104	110
Springfield (Mo.) Ry. & Lt., 7% pf.	101	96	103
Standard Gas & Elec., 8% pf.	64½	57½	64½
Standard Gas & Elec., 7% pr. pf.	107	103	110
Standard G. & E., com. $3.50—no par	63½	54	65½
Standard Pwr. & Lt., 7% pf.	100	98	102½
Staten Island Edison, pf.—$6—no par	100	99	101
Superheater, $6 com.—no par.	168	170	185
Syracuse Lighting, 7% pf.	107	105	110
Syracuse Lighting, 8% pf.	115	113	119
Syracuse Lighting, 8% com.—no par	*m*300	....	....
TAMPA ELEC., com. $2.	58	49	64
Tenn. Elec. Pwr., 6% pf.	97½	92	97
Tenn. Elec. Pwr., 7% pf.	107½	103	107½
Terre Haute, Ind. & East. Trac., 5% pf.	22	15	35
Terre Haute, Ind. & East. Trac., com	1	1	9
Tex. Pwr. & Lt., 7% pf.	*l*109	106	109
Tide Water Pwr., 8% pf.	109	105	110
Timken Roller Bear., com.—$4 no par.	78	78	142½
Toledo Edison, 8% pf.	115	112	116½
Toledo Edison, 7% pf.	*l*105½	....	....
Toledo Edison, 6% pf.	*k* 98	95	97
Toledo Edison, 6% com.	100	....	....
Tri-City Ry. & Lt., 6% pf.	97	85	99
UNITED GAS & ELEC., 6% pf.	101	98	102
United Gas & Elec., com.—no par.	*m* 57	....	....
United Gas & Elec. (N. J.) 5% pf.	70	70	73
United Gas Impr., 8% com.—50.	*c* 111½	89½	113½
United Lt. & Pwr., pf.—$4—no par.	52	46	55
United Lt. & Pwr., pf.—$6.50—no par.	95	84	99
United L. & P., com. A .48—no par.	13½	12½	15½
United L. & P., com. B .48—no par.	*a* 23	15	24
Utah Pwr. & Lt., 7% pf.	*l* 107½	104	108½
Utica Gas & Elec., 7% pf.	105	105	106½
Utica Gas & Elec., 8% com.	60	....	....
Utilities Pwr. & Lt., 7% pf.	95½	93	100
Utilities Pwr. & Lt., com. A $2.	31	27	34
Utilities Pwr. & Lt., com. B $1—no par.	17½	13½	19
VERMONT HYDRO-ELEC., 7% pf.	98	93	100
Virginia Elec. & Pwr., 7% pf.	107	104	110
Virginian Pwr., 7% pf.	*k*108	....	....
Virginian Pwr., com.	*k* 75	....	....
WAGNER ELEC., 7% pf.	*m* 87	68	90
Wagner Elec., com.—no par.	*b* 33	18½	39½
Washington Ry. & Elec., 5% com.	*j*260	....	....
Washington Ry. & Elec., 5% pf.	*j* 92½	....	....
Washington Wtr. Pwr., 8% com.	159	131	170
West Penn Elec., 7% pf.	110½	102	112
West Penn Elec., Cl. A $7.	*k*108	97½	110
West Penn Pwr., 7% pf.	114½	111	118
West Penn Pwr., 6% pf.	107	100½	108½
West Virginia Lt., Ht. & Pwr., 7% pf.	90	94	96½
West Va. Utilities, 7% pf.—50.	*m* 90	48	51½
Western Pwr., 7% pf.	*k* 99	98	101½
Western States Gas & Elec., 7% pf.	99½	96	103
Western States Gas & Elec., com.	37	....	....
Westinghouse Elec. & Mfg., 8% com.—50.	83½	67½	89
Weston Elec. Instrument, Cl. A $2—no par.	*k* 32	30	34½
Weston Elec. Instrument, com.—no par.	14	13½	18½
Wheeling Elec., 6% pf.	100	92	103
Worthington Pump, 7% pf. A.	*k* 52	46	61½
Worthington Pump, 6% B.	*k* 45	40	54½
Worthington Pump, com.	34½	20½	46
YALE & TOWNE com. $5—25.	*k* 82½	70½	83

Stock Exchange: *a*Chicago; *b*St. Louis; *c*Philadelphia; *d*Boston; *e*Baltimore; *f*Montreal; *g*Cincinnati; *h*San Francisco; *i*Pittsburgh; *j*Washington. *k*Bid price Saturday, Aug. 13. *l*Bid price Wednesday, Aug. 17. *m*Latest quotations available. †Dividend rate variable.

and 6 per cent preferred stocks will have the right to subscribe to the new stock on the basis of one share of new preferred for each four shares of any class of preferred stock held as of July 7, 1927, at $100 per share, payable in full or in ten installments of $10 per share monthly. The stock not subscribed for by the company's present stockholders will be offered to the general public under the popular ownership campaign.

New Capital Issues

The Commonwealth Power Corporation issued 6 per cent cumulative preferred stock to the amount of $13,208,200, the price being $100 per share and accrued dividends, to yield 6 per cent. Proceeds from the sale of this issue will be used to retire the entire outstanding funded debt of the corporation and for other corporate purposes.

The American Utilities Company offered an additional issue of first lien and refunding gold bonds, series A, 6 per cent, totaling $910,000, at 100 and interest. These bonds were dated Dec. 1, 1925, and mature Dec. 1, 1945.

Wagner Electric Calls Bonds.—First mortgage 7 per cent serial gold bonds of the Wagner Electric Corporation, totaling $150,000, dated Aug. 4, 1922 (numbered 201 to 350 inclusive), were called for redemption Aug. 1, 1927, at 100½ and interest.

Recent Listings.—Additional common stock of the Philadelphia Company (par $50) has been authorized for listing on the New York Stock Exchange on or after July 30 to the amount of $390,250, on official notice of issuance as a stock dividend, making the total amount applied for to date $47,220,300. The Baltimore Stock Exchange has authorized the listing of 429,848 shares of common stock (without par value) of the Pennsylvania Water & Power Company.

Pacific Lighting Changes Capital Set-up

Stockholders of the Pacific Lighting Corporation on Aug. 10 voted to change the authorized capital stock from 1,000,000 shares (par $100), consisting of 700,000 shares of common, 50,000 shares of 5 per cent preferred and 250,000 shares of 6 per cent preferred stock, to 10,000,000 shares of no par value to consist of 2,500,000 of six-dollar preferred stock, 500,000 shares of five-dollar preferred stock and 7,000,000 shares of common stock. The stockholders also approved the declaration of a 900 per cent stock dividend on the present common stock, equivalent to splitting the stock ten to one. The dividend is payable in no par common shares to holders of record Nov. 15.

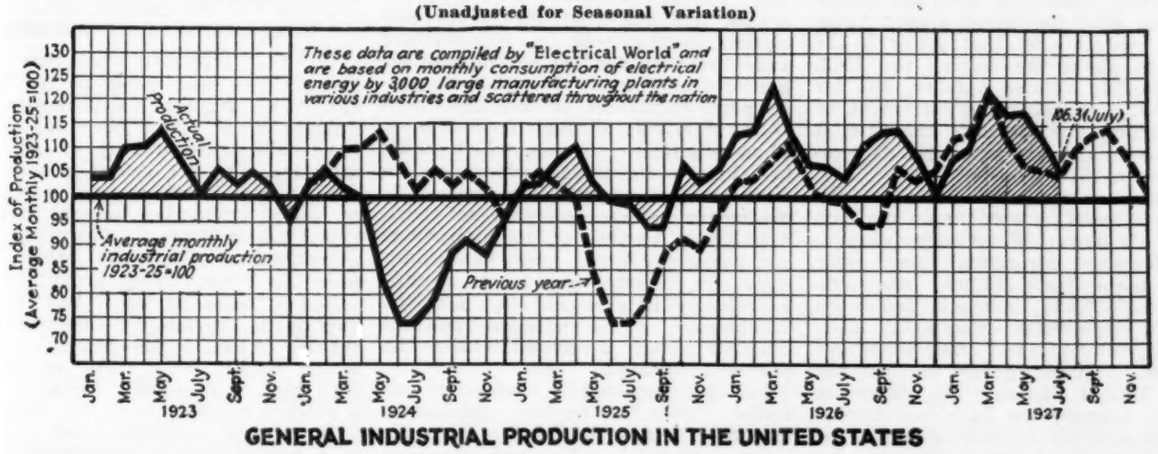
Industrial Activity Still Above Last Year

Seasonal Decrease Under That of 1925 and 1926—Production Conditions Spotty, Some Industries Up and Some Down

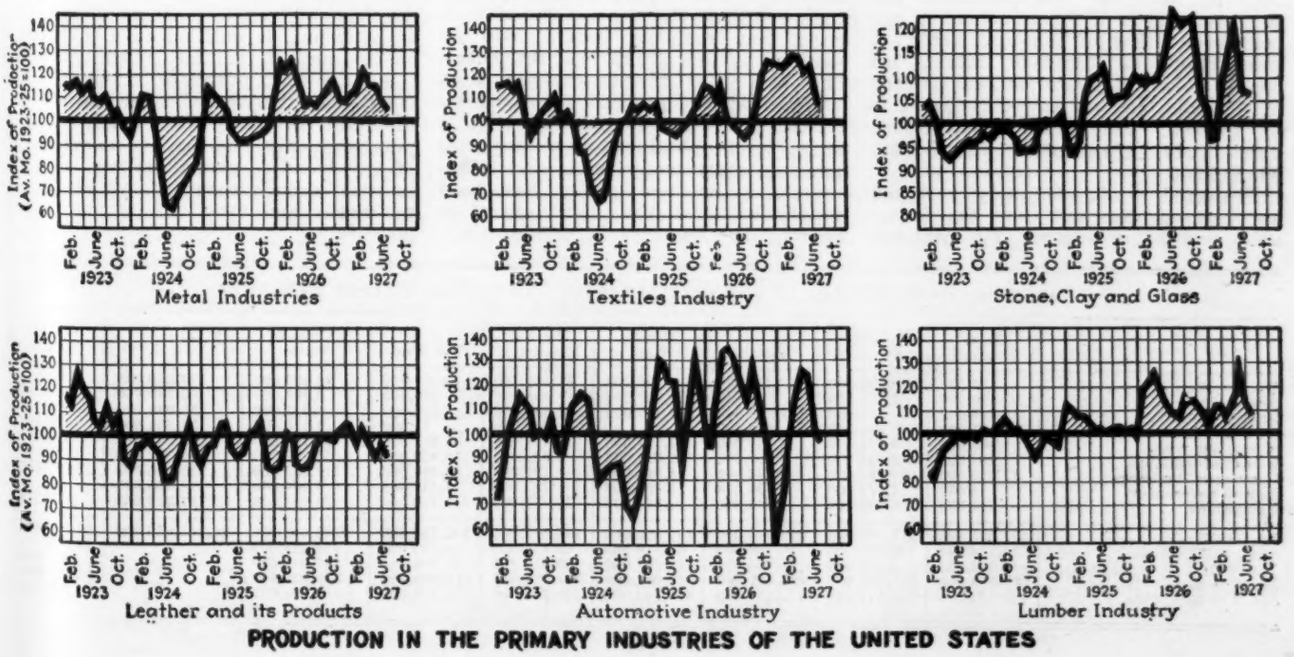
THAT the rate of operations in the manufacturing plants of the nation during the present summer are above those witnessed during the same period of last year or during the summer of 1925 is indicated by reports received by the ELECTRICAL WORLD from approximately three thousand large manufacturing plants scattered throughout the nation and in various industries—plants consuming over 15,000,000,000 kw.-hr. of electrical energy per annum. The figures for July indicate that the productive activities of general industry during that month were 4.7 per cent over July of last year and 12.7 per cent over July of 1925. The activities during July were less than 1 per cent under those of June, which is close to the seasonal trend between those two months witnessed during the past three years, last year, however, witnessing a slightly increased activity during July. The July rate of production this year was only 8.7 per cent under that of February, the month of peak activity during the past three years, which is a comparatively low rate of seasonal decrease when it is remembered that in 1926 this curtailment of productive activity during the same period was 14.9 per cent and that in 1925 it was 12.9 per cent. The indications are that general production during the present summer is holding up better than during any similar period since the war.

The basic reports indicate that production conditions were very irregular, as has been the situation since May. Some of the primary industries reported a drop in activity under last year of considerable importance, while others, it appears, were producing at an increased rate over the same month of last year. In the rolling mills and steel plants, for instance, reports from plants producing largely the raw products indicated a drop in activity under July of last year of from 2 to 9 per cent, while those plants turning out specialized products, such as wire, tubes, etc., reported operations on a par with or at a slightly greater rate than for July of last year. Seven of the industrial groups—the rolling mills and steel plants, leather, textiles, lumber, paper and pulp, rubber, and food—reported July production activities slightly above those of July last year. On the other hand, metal-fabricating plants, including both ferrous and non-ferrous plants, the automobile-manufacturing plants, stone, clay and glass, chemicals and allied products, and the shipbuilding industry, all reported a rate of production during July under that of July last year.

Both branches of the metals group recorded a decrease in rate of production under June, the activities of the group as a whole being 1.6 per cent under June. The operations within the automobile manufacturing plants continued to decrease, July operations being at a rate of 3.4 per cent under June and 6.4 per cent under July of last year. These figures, however, are indicative of general operations in these plants, including the turning out of automobile parts, and do not necessarily indicate the actual production of automobiles in the country during the month of July.


(Unadjusted for Seasonal Variation)
These data are compiled by "Electrical World" and are based on monthly consumption of electrical energy by 3000 large manufacturing plants in various industries and scattered throughout the nation
Index of Production (Average Monthly 1923-25=100)
Actual production
Average monthly industrial production 1923-25=100
Previous year
106.3 (July)
Jan. Mar. May July Sept. Nov.
1923 1924 1925 1926 1927

GENERAL INDUSTRIAL PRODUCTION IN THE UNITED STATES



PRODUCTION IN THE PRIMARY INDUSTRIES OF THE UNITED STATES

Manufacturing and Markets

Engineering Construction Is Ahead of Last Year

Projected Work in Slightly Smaller Volume—Decline in Industrial Building Heavy

CONTRACT letting in the heavy construction field during July reached a point 34 per cent above the average for that month during the last six years, according to the *Engineering News-Record*. This is not considering the situation from the standpoint of actual money value of contracts let, but rather upon a basis of materials and labor costs as they were in 1913, the last pre-war year. The construction volume index number for the month of July was 252, as compared with 228 for the whole of 1926 and 100 for 1913. This means that the actual volume of contract letting in 1926 (not the mere money value of the contracts let that year) is 128 per cent above the volume for 1913. The monthly volume number, 252 for July, 1927, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

Contract values in the accompanying table are based on a minimum for each class, as follows: Waterworks, excavation, drainage, irrigation, levee, river and harbor projects, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial, educational, institutional, religious and other buildings, $150,000. These figures are for the entire United States. The difference in costs between the July and August markets does not amount to even 1 per cent in favor of August, while the current level is a fraction over 1 per cent below that of August, 1926. A comparison of contract totals, all classes taken together for the country as a whole, and on a weekly basis, is as follows: July, 1927, $60,162,500; June, 1927, $70,485,600; July, 1926, $59,819,800.

Projected work, definitely reported as proposed, does not show the favorable picture presented by contract values. Comparison of proposed work on a weekly basis, all classes, for the entire United States, at minimum figures stated, is as follows: July, 1927, $71,735,250; June, 1927, $91,232,000; July, 1926, $80,374,200.

Between Jan. 1 and Aug. 1, 1927, projected work reached a cumulative total of $3,194,398,000, compared with $3,363,737,000 for the corresponding period last year. This difference of 5 per cent has strong possibilities of being evened up during the last half of the current year.

Mass Production and Mass Buying

Serious Consideration Should Be Given to the Establishment of a Business Policy in Each Industry and the Development of a National Political Business Policy

BY "OBSERVER"

THE endeavor of American business executives is to reduce costs, and the logical economic weapon to use is mass production and mass buying. But the inevitable result of following this economic law to its conclusion is monopoly in manufacture and purchases and the entire elimination of competition. Then follows government regulation or the dissolution of the monopoly through federal laws. Thus American business, which needs to utilize to the utmost every possible economic asset to maintain commercial prosperity in the international business group because of its high wage and living standards, needs to consider seriously the establishment of a business policy in each industry and the development of a national political business policy which will meet the present situation.

In the automotive industry one major group is rapidly gaining a monopoly because it uses the economic assets involved in mass production and mass selling. The present trend indicates that complete control will be obtained by this group in a few years. The plea that the automobile is a luxury may not prevent governmental activities in the eventuality that a monopoly is obtained. In the steel industry, after many trials and tribulations, a business policy has been established and put into operation whereby the business is divided on a percentage basis and prices are stabilized more or less as a result. It is claimed that such a plan leads to stagnation in business development and has other demerits.

WHAT OF ELECTRICAL INDUSTRY?

In the electrical industry little thought has been given to the major situation. But recent experiences have brought some broad questions to the front which are worthy of executive attention. In the electrical manufacture of such standard products as lead to mass production several developments are of interest. The merger and consolidation of utilities, which compose the large buying group, has resulted in mass buying. And in mass buying the purchaser claims that he is entitled to part of the economic benefits which result from mass production. This plea is especially strong because a holding company uses this argument to justify its existence. For example, it is stated that a two-million-a-year purchase of transformers, or of meters, or of lamps, is entitled to a discount, on account of volume, much greater than is given a purchase of, say, $100,000 a year. Yet these buyers claim that discounts are based on small-volume purchases only, and there is no evidence of any trend to give them part of the inherent economic benefits which large purchases and mass production make possible.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING MAY, 1927

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Jan. 1 to Date, U. S.	Canada
Waterworks	$59,000	$390,000	$294,000	$369,000	$1,108,000	$289,000	$2,509,000	**$33,313,000**	.....
Sewers	130,000	2,530,000	87,000	4,209,000	633,000	599,000	8,188,000	**63,262,000**	$149,000
Bridges	414,000	614,000	2,180,000	1,499,000	1,102,000	218,000	6,027,000	**72,038,000**	64,000
Excavations, drainage, etc.	107,000	752,000	824,000	.....	222,000	15,000	1,920,000	**31,566,000**	30,000
Streets and roads	1,847,000	9,454,000	6,863,000	7,547,000	8,487,000	5,012,000	39,219,000	**282,209,000**	916,000
Industrial buildings	1,231,000	2,468,000	7,565,000	9,611,000	3,882,000	10,420,000	35,177,000	**152,352,000**	650,000
Commercial buildings	17,650,000	59,582,000	2,293,000	18,346,000	6,193,000	13,499,000	117,563,000	**895,305,000**	3,950,000
Federal government	3,000	1,672,000	1,136,000	1,209,000	287,000	1,337,000	5,644,000	**28,305,000**	.....
Unclassified	566,000	630,000	748,000	1,016,000	20,133,000	1,310,000	24,403,000	**197,279,000**	90,000
July, 1927	$22,007,000	$78,092,000	$21,990,000	$43,806,000	$42,047,000	$32,708,000	$240,650,000	**$1,755,629,000**	$5,849,000
June, 1927	33,534,000	130,474,000	19,731,000	81,119,000	60,817,000	26,753,000	352,428,000	.....	19,747,000
July, 1926	33,994,000	63,483,008	25,964,000	94,285,000	59,613,000	21,760,000	299,099,000	.....	16,477,000
Jan. 1 to date, 1927	**142,079,000**	**541,210,000**	**125,461,000**	**422,835,000**	**310,784,000**	**213,260,000**	**1,755,629,000**	.....	**63,188,000**
Jan. 1 to date, 1926	137,193,000	516,319,000	182,504,000	404,762,000	250,709,000	167,619,000	1,659,106,000	.....	79,398,000

Thus the electrical manufacturer has a problem to contend with. If the large company does take advantage of the inherent economies possible with mass production, the small company suffers. It will have to sell a small order at a price equal to that given by the large manufacturer for a large order if it expects to do business. Therefore the logical outcome is that the small manufacturer goes out of business. Monopoly follows, and then anti-trust legislation or governmental regulation is invoked.

No Desire for Monopoly Expressed

But the electrical manufacturers have as yet expressed no desire for a monopoly in production. On the contrary, competition is asserted to be a most desirable and stimulating condition. The large manufacturers have nourished this condition by controlling their production and prices. In fact, it has been stated that the small producer of a product waited until the large producer had established his prices and then made a slight differential in his own prices to get an undue advantage in competition for possible business. In some instances recently there has been an indication that the larger manufacturers have decided not to "carry the ball" for the small manufacturer and intend to utilize more effectively their inherent economic assets to get business. Thus a policy of passing on to customers a share of the savings resulting from mass buying and mass production will tend to eliminate competition. Even though very few manufactured products in the electrical industry are subject to mass production of the type meant, there is no doubt that a sufficient number exist to create a critical situation.

There are thus two major ideas worthy of discussion and study by both buyers and producers:

1. Is it practicable and best to build up a business policy which ignores the economic law of mass buying and mass selling? In other words, shall the given volume of business be apportioned out on a percentage basis between manufacturers?

2. Is it practicable and best to utilize fully the economic assets of mass buying and mass selling, thereby having a monopoly situation?

Either question involves many considerations, and both lead to the inevitable conclusion that prices will be fixed on such products as come under the category discussed. On a policy basis, the price will be fixed by the manufacturer with the largest volume of business, and it would be difficult to operate the policy in a way to insure that all other manufacturers would maintain this price or would maintain the balance in business volumes first allotted them. Anti-trust laws are, of course, in the background, hovering ever near.

The idea of a monopoly line would result in either governmental regulation or governmental prohibition. In a sense, it is worthy of study to consider a monopoly situation whereby, with modern business cost accounting and ethics, the government would act as an observer and regulator, with little, if any, interference in monopoly business conducted fairly with respect to buyers and with all cards on the table.

No matter what the decision as to the ultimate solution of the American business problem and of the electrical industry business problem, there is indicated clearly a situation which calls for thought and action. The time is ripe to develop a program before conditions become critical. Any program will require changes in basic laws and conception of business.

Sales of Industrial Electric Locomotives Increase

	Mining Locomotives				Industrial Locomotives			
	Trolley Type		Storage-Battery Type		Trolley Type		Storage-Battery Type	
	Number	Value	Number	Value	Number	Value	Number	Value
1923								
Annual total....	1,024	$4,628,981	256	$858,969	24	$133,765	51	$199,739
1924								
Quarter ending:								
March 31...	112	$554,950	32	$111,895	19	$147,139	26	$105,463
June 30.....	98	486,493	36	124,396	9	150,112	12	49,902
Sept. 30.....	100	488,407	41	145,598	3	14,570	6	20,756
Dec. 31.....	118	545,871	35	122,701	10	162,560	6	27,831
Annual total....	428	$2,075,721	144	$504,590	41	$474,381	50	$203,951
1925								
Quarter ending:								
March 31....	105	$493,038	47	$163,275	4	$31,480	3	$11,331
June 30.....	91	436,352	31	104,802	4	35,178	15	101,716
Sept. 30.....	134	674,182	53	199,910	4	35,460	9	60,117
Dec. 31.....	182	880,257	46	162,039	11	167,305	5	35,926
Annual total...	512	$2,483,829	177	$630,026	23	$269,423	32	$209,090
1926								
Quarter ending:								
March 31....	127	$628,530	38	$126,380	4	$19,786	15	$56,231
June 30.....	153	751,542	45	146,951	2	16,780	7	33,578
Sept. 30.....	126	605,493	78	279,091	2	19,141	14	183,624
Dec. 31.....	247	1,224,222	57	199,527	18	229,917	57	130,568
Annual total....	653	$3,209,787	218	$751,949	26	$285,624	93	$404,001
1927								
Quarter ending:								
March 31....	202	$985,659	70	$257,701	4	$47,500	7	$81,365
June 30.....	153	732,851	56	235,116	9	51,025	15	34,820

Shipments of mining and industrial electric locomotives for the quarter ended June 30, 1927, as reported to the Department of Commerce by ten firms, composing virtually the entire industry, were 233, valued at $1,053,812, or 12 per cent more in number and 11 per cent more in value than for the quarter ended June 30, 1926. The largest volume of sales, as usual, has been in the mining field, the trolley type totaling about three times the storage-battery type. In the industrial field the ratio is barely one and a half to one. Storage-battery locomotive sales have increased 60 per cent so far as value is concerned and 24 per cent in number in the mining field, while the sale of trolley type has just held its status of a year ago.

Business Conditions

BUSINESS throughout the country is uniformly quiet, but manufacturers' representatives report that it is as good as was anticipated. In New England sales of supplies, small apparatus and line materials are steady and inquiries are increasing slightly from utilities and industrials. Shoe and textile equipment sales are picking up. Industrial heat applications and street lighting are noticeable. Utility sales in the Southeast are off except for transformers and meters, but textiles are active. Building equipment and staples feature Pacific Coast purchases, and motor and appliance sales are numerous but scattered and small in the Northwest. The slight improvement of last week continues in the Middle West, more activity being noticeable in utility construction despite conservatism. Railroad and industrial buying is helping. The district around New York is apparently influenced by close proximity to the financial center, sales being quiet.

Metal Prices Weaken in Dull Markets

Prices for all of the major nonferrous metals were lower on Aug. 17 than they were a week prior. The change is great in neither lead nor zinc, and although copper is quoted 17.5 points in the domestic market, it is significant that the sales were exceptionally small and the principal producers are uniformly out of the market. The impression prevails that most of the cheaper metal has been taken up and that buyers will have to meet the higher prices of the larger sellers. Prices in London likewise are generally down.

Second hands and custom smelters for the most part have done what little business was transacted in a very dull copper market this week. The larger selling agencies realized 13⅜ cents in Connecticut last Thursday and 13.50 cents at high freight-rate points as late as Saturday. The most

NEW YORK METAL MARKET PRICES

	Aug. 10, 1927 Cents per Pound	Aug. 17, 1927 Cents per Pound
Copper electrolytic	13.05	13.10
Lead, Am. S. & R. price	6.75	6.65–6.75
Antimony	12	11¾
Nickel, ingot	35	35
Zinc spots	6.725	6.70
Tin, Straits	65.25	63.75
Aluminum, 99 per cent	26	26

Base copper price Aug. 17, 1927, 15¼ cents.

encouraging feature in the statistics issued was the unmistakable trend toward lower mine production in the United States.

Though no change has been made in the American Smelting & Refining Company's contract price for New York lead, which remains at 6.75 cents, the market is distinctly weaker. On Aug. 16 and 17 one of the principal producers was firm at 6.40 cents, St. Louis, though other sellers were willing to accept orders at 6.35 cents. Increased production in Mexico and Australia is offset by a surprising decline in Burmah.

New England Buying Non-Spectacular but Steady

Steady sales of supplies, small apparatus and line material characterize the New England market. Inquiries are increasing for apparatus for industrial and utility service. Distinct improvement is recorded in the shoe-manufacturing field; building operations are going forward in large volume, and while general business is spotty and subject to seasonal fluctuations, a healthy fall trade is anticipated. The First National Stores, Inc., has completed competitive tests of industrial electric trucks and is on the point of awarding a contract for eight units, including two tractors, and also an electric conveyor system. Sales of textile machinery are picking up, and much of this is individually driven. Many inquiries are being received for industrial electric heating equipment, and additional sales of lead pots for newspaper service are expected soon. Street-lighting material is in fair demand, and rectifier outfits have been sold for eastern Massachusetts. A fair volume of scattered orders for high tension substation material is going through branch offices, and demand metering for inter-connected lines is receiving attention. Jobbers are busy selling cable and conduit, and electric ranges and refrigerators are running well above last year.

Textiles Active in South, Meters Interest Utilities

Central-station purchasers last week were off from the past few weeks, though the total volume may be considered reasonably satisfactory. Transformers were in most active demand, one company in Alabama ordering $25,000 worth of power transformers, while a South Carolina utility ordered power transformers totaling $10,000. A Georgia company ordered small power and distribution transformers amounting to something over $4,500. Meters are active, total sales for the territory showing a sharp pick-up during the past two weeks, and the Georgia territory is taking this equipment in very satisfactory volume. While the movement of line construction materials is somewhat slower than for some time past, some companies are buying in reasonably good volume, one company ordering last week $1,800 worth of creosoted pine poles and wire and cable to the extent of approximately $2,000.

Textiles are active, as regards both additions to plants and electrification projects, and the total volume of small textile orders is reported good. One textile mill in Georgia ordered last week motor equipment totaling $10,000, while another plant in the same state purchased $8,000 worth of this equipment. One of these mills also ordered three 333-kva. transformers. There is quite a bit of this industrial business pending, and the fall months should witness a brisk activity in this line.

Puget Sound Motor Sales Numerous but Scattered

Motor and apparatus sales in Seattle, while fairly numerous, are scattered and small, being mainly for replacements, additions and to dealers. Sales reported from smaller Puget Sound cities are negligible, but a large amount of buying is anticipated soon for a proposed pulp and paper mill and an addition to a large lumber mill in Tacoma. Industrial plants there are also doing considerable buying. The Kelso Paper Company will start building a plant on Sept. 1.

Motor sales reported last week include 20 motors rated at from 25-hp. down for two central-station companies; 25, from 50-hp. down, for several lumber mills and woodworking plants; 20, from 25-hp. down, for machine shops and foundries; ten, from 5-hp. down, for refrigeration plants; ten, from 10-hp. down, for two water districts; two 20-hp. motors and a 15-hp. motor for a flour mill, and 40, from 75-hp. down, including several of 20-hp. and several of 7½-hp. to dealers.

The Seattle Board of Public Works is taking bids until Sept. 9 for construction of the Diablo hydroelectric development on the Skagit River, costing $2,500,000.

Building Equipment and Staples Features on Coast

Manufacturers report a week featured by staple business, such as 25/15-hp oil-well motors and 5-kw. to 100-kw. distribution transformers. Fifty street-lighting units, valued at $6,000, were sold to a Sacramento Valley City, and Fresno is considering a similar installation.

Hospital business, which has been excellent all year will be supplemented by more at Los Angeles, San Francisco, and Redding. A California state bid calls for $2,300 worth of conduit fittings for the University of California library. Inquiries cover two carloads of 55-ft. poles and 1,000 guy anchors for the San Joaquin Valley and two carloads of 35-ft. and 40-ft. poles for San Luis Obispo. Other bids are requested for $500 worth of park cable, $2,000 worth of fiber conduit and $3,000 worth of rubber-covered wire for a veterans' hospital in Arizona. Ten thousand dollars' worth of poles have been bought for a telephone line from Marconi to Sausalito, Cal. Machinery orders include two 200-hp. motors for a lumber company, 200 ¾-hp. washing-machine motors, a 125-hp. oil-well drilling motor and a welding set for a logging company.

Utility Buying Quiet, Industrial Fair, Around New York

The market for electrical apparatus among central-station companies in the New York district is quiet, and several manufacturers classify buying as of the "hand-to-mouth" type. Inquiries, too, have decreased in volume during the past week. Several interesting projects are reported as under consideration, however, although negotiations for the electrical equipment have not yet been opened. Industrial buying continues fair, and the demand for transformers among this class of users is good. Sales of small motors are also fair, although here, too, individual orders are being generally limited to small quantities. The demand for medium and large-size motors is somewhat spotty and inclined to be dull. Jobbers also report a somewhat unsteady market, with a little increase in strength of conduit, fittings and other materials of this type.

Middle West Market Shedding Dullness

The volume of business in the Middle West is not large, but the slight improvement noticeable at the beginning of the month continues this week and in all probability will continue to the end of the month. The utility companies are still pursuing a conservative policy, but more active purchasing is noticeable. Maintenance purchasing is quite heavy, one large utility's daily commitments averaging approximately $86,000 a day. More construction work is being started and a large amount of line extension work is going on. Manufacturers of pole-line hardware report a good volume of business.

Jobbers' sales have increased somewhat and better business is anticipated. Appliances are moving in fair volume with no particular concentration on any one appliance. Considerable business is being obtained from the railroads, and industrial activity, while still somewhat spotty, is contributing to the increased business of the jobber. Prices remain generally firm. One manufacturer of lead-covered wires and cables advanced the price of this commodity approximately 1 per cent this week—apparently to cover the slight increases in lead covering. A greater advance is anticipated to cover advancing prices of other materials.

A good, steady demand has been maintained around St. Louis in all lines of the electrical industry. The demand for building construction materials is on the increase. Medium-sized motors are being purchased in good quantity for manufacturing plants. Statements have been made by manufacturers' representatives that so far August business has come up to their estimates as to volume. Jobbers report a steady demand for motors, transformers, street-lighting equipment and pole-line materials.

Activities of the Trade

Andrews-Bradshaw Acquires Tracy Engineering Company

The Andrews-Bradshaw Company, Pittsburgh, which has for some time past owned a controlling interest in the Tracy Engineering Company of San Francisco, has recently acquired full ownership of that company's entire plant. While many of the original basic patents were held jointly by the two companies, the purchase of the Tracy Engineering Company gives the Andrews-Bradshaw Company absolute title to all the "Tracyfier" patents. The Tracy Engineering Company has been manufacturing the "Tracyfier," formerly known as the Tracy steam purifier, in its San Francisco plant, while the Andrews-Bradshaw Company has been selling the "Tracyfier" throughout the United States, Cuba, Hawaii and the Philippine Islands.

Since the purchase of the Tracy Engineering company by the Andrews-Bradshaw Company, the factory has been moved to Pittsburgh. The company states that the change in factory location has made it possible to introduce new methods of manufacturing, and higher standards of accuracy, which have been accomplished principally by the installation of a number of new machines and by several changes in the process of manufacture.

Fuse Discounts and Switchboard Lists Change

Effective Aug. 10, discounts on 250-600-volt, 4-200-amp. non-indicating, non-renewable fuses, bought under contract in quantities of ten or more cartons, carton, or less than carton, are 65, 56 and 37 per cent respectively. Without contract the corresponding discounts are 62, 53 and 33 per cent, according to the Westinghouse Electric & Manufacturing Company. Fuses of different capacities and voltages when ordered in carton lots may be combined to make up ten-carton quantities.

In addition, list prices on switchboards (styles 389,622 to 389,628 inclusive) have been increased from $49 to $130, the new prices on these styles ranging from $228 to $415.

Blaw-Knox Company Purchases Milliken Brothers

The Blaw-Knox Company, with general offices at Pittsburgh and with plants at Blawnox, Pa., and Baltimore, Md., has purchased the Milliken Brothers Manufacturing Company of New York. The consolidation of the two companies will become effective on Sept. 1. The Blaw-Knox Company manufactures a line of steel specialties, including steel forms for concrete construction, steel buildings, open-hearth furnace equipment, air preheaters, hammer-welded products, steel transmission towers, automatic concrete, measuring devices, steel bins, clamshell buckets, etc.

The Milliken Brothers Manufacturing Company was originally organized as Milliken Brothers, Inc., in 1857. The products of the Milliken company are transmission towers, radio towers and standard steel buildings. A considerable amount of the business of the Milliken company has been in the export field, and the present Milliken organization will continue to function in this field and in addition will take over the management of the export business of the Blaw-Knox Company on all of its products. The Blaw-Knox Company will continue with its present organization to handle domestic business, and the acquisition of the Milliken company will make no change in this line. Manufacturing for both companies will be concentrated at the Blaw-Knox plants at Pittsburg and Baltimore.

Packard Electric Sells 6,600 No-Par Common Shares

An offering of 6,600 shares of no-par common stock of the Packard Electric Company, Warren, Ohio, has been sold. This sale is preliminary to an offering of $650,000 worth of 6 per cent, ten-year sinking-fund convertible gold debenture bonds, proceeds from which will be used to retire outstanding bonds and preferred stock of the predecessor companies, reduce floating indebtedness and provide additional working capital. When this is done, the capital will consist of $650,000 debentures, and 30,600 shares of no-par common, 16,400 shares remaining in the treasury for debenture conversions.

Servel May Assess Stock $4 Per Share

While the actual details of the Servel reorganization plan cannot be worked out until the final figures are received by the reorganization committee, it is contemplated that the stock of the Servel Corporation shall be assessed $4 per share and that stockholders will receive first mortgage bonds to the amount of their assessment and voting trust certificates representing 50 per cent of their present holdings in common stock of the new company. The holders of five-year 6 per cent convertible notes, it is understood, will receive voting trust certificates for 50 per cent of the principal of their notes in new preferred stock and probably voting trust certificates for 25 or 30 shares of new common stock for each $1,000 principal amount of indebtedness. The exact treatment to be accorded to creditors of the various subsidiary companies in the hands of the receivers will depend on the final figures yet to be made up, but it is understood that they will be settled with mainly by the use of voting-trust certificates for new preferred and common stock.

According to the June 30 statement of the Servel Manufacturing Company, total assets amount to $7,740,741, of which $2,807,046 is represented in real estate, buildings, machinery and equipment and $3,018,634 in inventories. Liabilities amount to $1,489,648 and capital stock and surplus to $6,139,058.

The Line Material Company, South Milwaukee, Wis., is building a new three-story addition, 60 ft. by 120 ft.

The Maring Wire Company of Muskegon, Mich., manufacturer of magnet wire, announces that it has let contracts for a branch factory, containing about 25,000 sq.ft. floor space, to be constructed at Anderson, Ind. The executive offices will be maintained at Muskegon.

The Edison Electric Appliance Company, Chicago, has concluded negotiations for the purchase of a tract of about 22,000 sq. ft., adjoining its plant at Ontario, Cal., to be used for the construction of a new addition. It is understood that a general expansion program will be started later in the year and carried into 1928 to provide for a considerable increase in present output.

The Penn Electrical Company, Irwin, Pa., manufacturer of switchboards and panelboards, announces that the W. C. Fletcher Company, Indianapolis, has taken over the sale of its products in that section. C. O. Baird will be in charge of the sales of that line.

The Decorative Lamp & Shade Company announces the removal of its plant to 1217 Spring Garden Street, Philadelphia.

The Union Electric Manufacturing Company, Milwaukee, manufacturer of control equipment, announces the opening of a district office at 801 Tchoupitoulas Street, New Orleans, to serve the states of Louisiana and Mississippi. G. P. Robbins and G. P. Robbins, Jr., are in charge.

J. D. Wallace & Company, 134 South California Avenue, Chicago, is now offering a new type of electric handsaw.

The Taylor-Colquitt Company, Spartanburg, S. C., distributors of treated and untreated ties, poles, piling and timbers, announces the opening of an office in New York at 75 West Street,

The Westinghouse Electric & Manufacturing Company has received an order from American Rolling Mill Company of Middletown, Ohio, for approximately $700,000 worth of electrical equipment.

The Killark Electric Manufacturing Company, 3940 Easton Avenue, St. Louis, is offering a new type of conduit fitting, known as the SLB, which is used to make a right-angle bend in a service entrance conduit on the outside of a building.

The American Signs Corporation, Kalamazoo, Mich., manufacturer of electrical display advertising, announces the appointment of A. Mark Smith as sales manager. The company also has opened an Eastern district office in the Flatiron Building, New York City, in charge of John Casey. The floor space of the company's factory recently has been increased, new machinery installed, and a new department for manufacturing metal glass interior electrical directional signs has been formed.

New Equipment Available

Skip-Hoist Control

A new form of skip-hoist control equipment, which is available in either the semi-automatic or fully automatic type, has been developed by the Industrial Controller Company, Milwaukee. The control is of the low voltage-release type. The panel and starting resistor of this control are mounted on a framework which is easily removable from the enclosure and permits of simple external wiring. All parts composing the control are stock parts which are easily replaced. The equipment is available for the control of either alternating-current or direct-current motors.

Atomic Hydrogen Welding

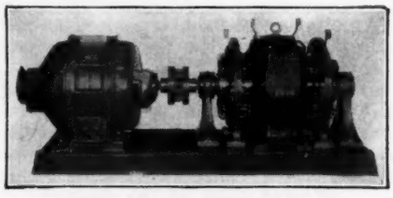
Equipment for atomic hydrogen welding—the process by means of which hitherto unweldable metals can be melted and fused without the slightest trace of oxidation, and welding can be performed in some cases on metals but a few mils in thickness—has been placed on the market by the General Electric Company. This process, making possible the welding of many special alloys and the production of ductile welds in iron and steel, is the result of research conducted by Dr. Irving Langmuir of the General Electric research laboratory. In brief, this method utilizes the passage of a stream of hydrogen through the arc between two electrodes. The heat of the arc breaks up the hydrogen molecules into atoms. These combine again a short distance beyond the arc into molecules of the gas, and in so doing liberate an enormous amount of heat, so that more effective welding temperatures can be obtained than with the usual welding methods.

Since atomic hydrogen is a powerful reducing agent, it reduces any oxides which might otherwise form on the surface of the metal. Alloys containing chromium, aluminum, silicon or manganese can thus be welded without fluxes and without surface oxidation. Thorough trials, extending over a period of many months, were conducted by the company in its shops before introducing the new equipment. The apparatus, as finally designed, represents the result of continued experimentation and research. The welding outfit consists of a single-phase transformer for converting the voltage of a 60-cycle source of power to one suitable for the welding equipment, a specially designed variable reactor to provide the proper welding current and voltage for different classes of work and the welding torch by means of which the actual work of welding is performed.

In making edge welds the metal to be welded is melted under the heat of the arc, but when it is necessary to add additional metal a filler rod must be used and fed into the arc in much the same manner as is followed in the ordinary gas welding process. The new equipment is so far being marketed for operation from 60-cycle, single-phase circuits only and is recommended for use on ordinary metals of less than ¾ in. in thickness, or on hitherto unweldable metals of greater thickness. Metals having a thickness of but 10 mils can easily be welded.

Electroplating Motor-Generator

A wide range of sizes of electroplating motor-generators has been added to the existing line of low-voltage motor-generators manufactured by the Electric Products Company, Cleveland. To insure perfect commutation under the wide variety of load and voltage conditions encountered in chromium plating, the generators are designed with as many interpoles as main poles. The generators are shunt-wound or compound-wound, the percentage of compounding



MOTOR-GENERATOR DEVELOPED FOR ELECTROPLATING

being governed by the conditions of service. The brush holders are of the latest-design reaction type. The generator field ring is made of rolled steel, electrically welded, insuring uniform distribution of flux and guaranteeing the satisfactory commutator design. With these motor-generators are furnished panels, including special overload protection, which is reported to be positive in action. If the current at any time exceeds a predetermined safe value, the voltage of the generator is automatically reduced to a safe value.

Dead-End Assembly

A new dead-end assembly for low-voltage feeder cable, placed on the market by the Ohio Brass Company, Mansfield, Ohio, is designed for any size feeder wire from 500,000 circ. mil. to 1,000,000 circ. mil. When dead-ending heavy feeders at a corner by using this new device, it is not necessary to strip the insulation back, pass the cable through the insulator and serve individual strands. This new product is doubly insulated by interlocked wet ware porcelain, has a high strength factor, all metal parts being of galvanized "flecto" iron, and is so compact that the use of ladders for installation is not required. The strain clamp put on the market with the dead-end assembly permits turning corners on two or more poles without cutting or dead-ending the feeders in both directions and is designed so that the feeder can carry straight through without any contact with the insulator assembly.

Across-the-Line Starter

An automatic across-the-line starter with push-button control and having a maximum rating of 7½ hp. for two-phase and three-phase, three-wire and four-wire motors and a maximum rating of 5 hp. for single-phase motors at 220 volts, 60 cycles, has been placed on the market by the Square D Company, Detroit. This starter can be used for either manual or automatic reset. The contactors have a combined sliding and rolling motion which is said to provide a clean operating surface. An emergency switch or lock-off is also provided. A knife switch opens the starter, which cannot be closed by pushing the start button until the knife switch is closed again.

The starter provides low-voltage protection on three-wire control and low-voltage release on two-wire control. The heating elements are interchangeable, so that the same starter can be readily adapted to the different motor ratings within its range.

Flow Indicator for Transformer Water Cooling

A water-flow indicator for indicating in gallons per minute the flow of water in or out of the transformer, depending on whether it is piped to the inlet or outlet of the cooling coil, has been developed at the Pittsfield works of the General Electric Company. The device operates on the Venturi principle. The indicator is constructed throughout of weatherproof materials, the body is of heavy bronze castings, and all other parts are of non-corrosive metals.

The indicator is supplied with two sets of electrical contacts for alarm circuits, designed to handle up to 260 volts, 5 amp., alternating or direct current. At any point on the scale one contact is always closed. When the hand passes a certain flow one circuit is interrupted and the second circuit is closed. This change point may be varied over the whole range of the scale. Neither contact is grounded. Each indicator is provided with a cavity in the upper casting for the insertion of a 150-watt, 110-volt heating unit, which is required only in cold climates where the indicator is on the inlet side of the cooling coil. The indicator can be completely dismantled and reassembled without changing the calibration, and it cannot be injured by foul water, as no water flows past moving parts.

Heavy-Current Electrode Holder.—A 600-amp. metal electrode holder has been placed on the market by the Lincoln Electric Company, Cleveland. This holder handles metal electrode in sizes up to ½ in. in diameter and is known as the type TR. Many improvements are claimed for the holder, among them being replaceable copper jaws, four-line contact for the electrode, all copper path for welding current, structural steel construction

(maximum strength), light weight with good balance, cool insulated and ventilated handle and shield for protection of the operator's hand.

Parallel Rule Attachment. — The Pease parallel rule attachment, which is constructed entirely of metal and consists of very few parts, has been placed on the market by the C. F. Pease Company, 850 North Franklin Street, Chicago. The complete mechanism is entirely beneath the table top and does not extend at any point. Four sprocket wheels connect the double chain drive and a revolving shaft between two of the wheels maintains uniform operation. The manufacturer states that the attachment is a simple device which can be easily installed on any style of board.

Wire Stripper.—A wire stripper operated by a floor pedal and which can be used for stripping any kind of installation has been placed on the market by the Foley Saw Tool Company, 9 N. E. Main Street, Minneapolis, Minn. The length of the strip can be varied without special adjustment. Notched steel jaw plates provided are easily interchangeable to handle all sizes of wire, and space on the plates is provided for cutting wire.

New Trade Publications

HIGH-TENSION SWITCHING AND PROTECTION.—The Delta-Star Electric Company, 2400 Fulton Street, Chicago, has issued a 48-page publication devoted to high-tension switching and protective equipment. This publication, known as bulletin No. 32-B, has a picture thumb index to facilitate quick location of any desired equipment. Copies will be sent upon request.

PORTABLE AIR COMPRESSOR.—Bulletin No. 133 issued by the Pennsylvania Pump & Compressor Company, Easton, Pa., covers the Pennsy-portable air compressor, model "121."

MOTOR DRIVE FOR COMPRESSORS.—The Ideal Electric & Manufacturing Company, Mansfield, Ohio, has issued circular No. 500 entitled "Flywheel Effect Recommendations for NH_3 and CO_2 Compressors Based on Ideal Synchronous Drive." The booklet contains graphic curves showing the relation between current pulsations and flywheel effect for compressors of all different types of construction. A method of obtaining flywheel effect for any speed is outlined, and various examples show the application.

WATER AND OIL METERS.—"A Trip Through the Worthington Meter Factory" is the title of bulletin W-821 issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York City, in which it describes and illustrates its self-contained manufacturing unit devoted to the production of water and oil meters.

POLE-LINE HARDWARE.—The Oliver Iron & Steel Corporation, Pittsburgh, Pa., is distributing its price sheet OH-2, covering the Oliver pole-line hardware.

MEASURING INSTRUMENTS.—Bulletin No. 150 issued by Herman H. Sticht & Company, 15 Park Row, New York, N. Y., describes and illustrates its new "Ground-Ohmer," an instrument designed for measuring ground resistances.

BUCKETS.—Bulletin D-1 issued by the Harnischfeger Corporation, Milwaukee, describes and illustrates the "P&H" dragline buckets.

CIRCUIT BREAKERS, SWITCHING AND CONTROL EQUIPMENT.—Bulletins GEA-703, GEA-771 and GEA-758 issued by the General Electric Company, Schenectady, N. Y., describe and illustrate the General Electric station oil circuit breakers, 7,500 to 35,000 volts and 500 to 4,000 amp., automatic switching equipment and automatic-station control equipment, respectively.

SAG-TENSION CALCULATIONS. — A booklet issued by the Aluminum Company of America, Pittsburgh, Pa., entitled "A.C. S.R. Graphic Method for Sag-Tension Calculations" contains tables showing both permanent and temporary sags and tensions and tables of catenary constants. Numerous charts showing various stress-strain curves, catenary constants, etc., are included.

NICKEL-ALLOY STEEL PRODUCTS.—The International Nickel Company, Inc., 67 Wall Street, New York City, is distributing the second edition of its buyers' guide for nickel-alloy steel products.

ELECTRIC FURNACES, MELTING POTS AND CARTRIDGE UNITS.—Bulletins GEA-37A, GEA-164A and GEA-104 issued by the General Electric Company, Schenectady, N. Y., describe and illustrate the General Electric direct-heat electric furnaces, types AD, RRB and RRC, electrically heated metal melting pots, type RP, and cartridge heating units, respectively.

INSTRUMENTS.—Supplement No. 1 to bulletin No. 300 issued by the Roller-Smith Company, 233 Broadway, New York City, describes and illustrates the Roller-Smith portable direct-reading type COM ohmmeter and the type HTD circuit tester recently developed by the company.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Turin, Italy (No. 26,889), for electrical household appliances.

Purchase is desired in Hamburg, Germany (No. 26,858), of electrical household refrigerators and dish-washing machines.

An agency is desired in Vienna, Austria (No. 26,890), for insulating material (linen tape and varnished cambric).

An agency is desired in Durban, South Africa (No. 26,891), for electrical stoves.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

Middle Atlantic States

GENEVA, N. Y.—Work has been started by the Empire Gas & Electric Company on the installation of a new street-lighting system covering the entire city. The chief feature of the new system is the replacing of the cluster lamps in the business district with single lamps of 600 cp. Single-lamp standards will also replace the two-lamp fixtures on boulevards and parkways. A complete automatic traffic control system will also be installed.

NEW YORK, N. Y.—Plans are being prepared by the New York Edison Company for alterations and improvements in its equipment storage and distributing plant at 1840 First Avenue, to cost about $40,000.

PLATTSBURG, N. Y.—The Plattsburg Gas & Electric Company has applied for permission to extend its distributing system in the towns of Plattsburg, Beekmantown, Chazy and Saranac under franchises by the respective town boards.

ALLENTOWN, PA. — Plans have been approved by the Central Railroad of New Jersey, 143 Liberty Street, New York, for the installation of an electric retarder control system at its local freight yard. Cost about $85,000.

BRADFORD, PA.—Plans are under way by the Bradford Electric Company for an equipment storage and distributing plant on Chestnut Street, to cost about $70,000.

EVERETT, PA.—The Penn Central Light & Power Company, Altoona, has purchased the Everett Electric Light, Heat & Power Company and will consolidate with its properties. Plans are under consideration for extensions in transmission lines in this section.

JOHNETTA, PA.—The West Penn Water Company has acquired the Johnetta Electric Company and plans extensions in transmission lines in this section. The Patton Electric Company, Patton, also has been taken over and transmission lines will be extended in that district.

ELIZABETH, W. VA.—The Monongahela-West Penn Public Service Company, Fairmont, plans the construction of a transmission line to Elizabeth and vicinity. A substation and distributing system will be installed.

BIG STONE GAP, VA.—The Stonega Coke & Coal Company, Minor Building, plans the construction of power substations at its mining properties at Stonega, Keokee, Dunbar, Arno, Exeter, Imboden and Roda.

WASHINGTON, D. C.—Bids will be received by the Chief of Engineers, United States Army, Washington, until Sept. 2, for 7,548 ft. of controller cable, rubber insulated, and three reels (Circular 7).

WASHINGTON, D. C.—Bids will be received by the Board of District Commissioners, District Building, Washington, until Aug. 25, for 55,761 ft. of composite telephone and signal cable for the electrical department.

WASHINGTON, D. C.—The Supply Officer, Navy Yard, Washington, will purchase 70 transformers under open market req. NSA 72.

North Central States

IRONWOOD, MICH.—The Lake Superior District Power Company has filed plans for extensions and improvements in its local substation.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until Aug. 26 for fiber conduit for the Division of Light and Power.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until Aug. 26 for series multiple transformers for the Division of Light and Power.

BELLAIRE, OHIO.—The installation of a new uniform street-lighting system throughout the city is under consideration by the City Council and local business men. The street-lighting service is supplied by the Wheeling (W. Va.) Electric Company.

COLUMBUS, OHIO.—Steps have been taken by the Front Street Improvement Association to secure the installation of an ornamental lighting system on Front Street.

LOUISVILLE, KY.—The Kentucky Service Company, Louisville, plans to erect a line from Irvington to Garfield, Ky.

HAMMOND, IND.—Bids will be received by the State Line Generating Company, 72 West Adams Street, Chicago, Ill., until Aug. 30, for steel superstructure for its proposed steam-operated electric power plant on the state line between Indiana and Illinois. Graham, Anderson, Probst & White, 80 East Jackson Boulevard, Chicago, are architects.

COUNCIL BLUFFS, IOWA.—The Citizens' Gas & Electric Company plans extensions and improvements in its central substation. An underground conduit system will be installed in the business district. The entire project will cost about $175,000.

SHELDON, IOWA.—The Western States Public Utilities Company, Lincoln, Neb., plans to build a local steam-operated electric power plant to cost about $200,000. A transmission line will be built.

SWAN, IOWA.—A franchise has been granted the Des Moines (Iowa) Electric Light Company to furnish electric service here. The company plans to extend its line from Pleasantville to Swan.

IOWA CITY, IOWA.—The installation of an ornamental lighting system, to cost about $25,000, is under consideration by the City Council.

CHICAGO, ILL.—Plans are under way by the Illinois Power & Light Corporation for the erection of an electric transmission line from its substation on the Abington Road, near Monmouth, to Cameron.

WAYNESVILLE, ILL.—The Illinois Public Utility Company, Lincoln, which has acquired the municipal electric plant, has been granted a 30-year franchise.

SHAWANO, WIS.—Permission has been granted the Wisconsin Power & Light Company, Madison, by the Federal Power Commission to appropriate waters from the Wolf River in Shawano County, for a proposed hydro-electric plant, to cost about $400,000.

REDFIELD, S. D.—A franchise has been granted to the Northwestern Public Service Company, which has acquired the municipal electric plant.

ST. LOUIS, MO.—The Board of Public Service h s filed plans for the construction of a one-story-and-basement substation at 4011 Oleatha Street, to cost about $27,000.

DE WITT, NEB.—The City Council has appropriated $10,000 for additions, betterments and maintenance of the municipal lighting plant for the year.

NORMAN, NEB.—The City Council is considering a proposition for the construction of a municipal electric lighting plant.

Southern States

THOMASTON, ALA.—The Alabama Power Company, Birmingham, plans to erect a transmission line from Linden to Thomaston, with installation of a distribution system.

PINEOLA, N. C.—Plans have been prepared by Mees & Mees, Inc., Johnston Building, Charlotte, consulting engineer, for a hydro-electric plant, near Pineola, for Howard C. Marmon and associates.

OLD HICKORY, TENN.—Plans are under consideration by the duPont Rayon Company, River Road, Buffalo, for enlarging the power division at its local mill, including the installation of additional machinery. The cost of the entire project is estimated at $4,000,000.

ROGERS, TENN.—An ordinance creating district No. 1 in Rogers, for the purpose of constructing or purchasing a water and light plant adequate for the needs of the city has been adopted by the City Council.

NEW ORLEANS, LA.—Steps have been taken by the Jefferson Davis Parkway Improvement Association for the installation of an ornamental lighting system along the Jefferson Davis Parkway.

NEW ORLEANS, LA.—Extensions and improvements to cost about $55,000,000 are contemplated by the New Orleans Public Service, Inc., during a period of years. The work will include new power plants, extensions in present generating stations, substations, transmission lines, etc.

WHITE CLIFFS, ARK.—The Arkansas Portland Cement Company, Little Rock, recently organized, contemplates the construction of a power plant at its proposed local cement mill. The entire project will cost about $2,000,000.

WOODWARD, OKLA.—The Oklahoma Gas & Electric Company, Oklahoma City, is reported to be planning the construction of a transmission line in this district. The company is negotiating for the purchase of the municipal light and power station.

CLARENDON, TEX. — The Central Power & Light Company, San Antonio, is planning to build a local power plant, to cost about $25,000. The company is also planning the construction of a power plant near Fort Davis, where franchise has been secured.

Pacific and Mountain States

BELLINGHAM, WASH.—An ordinance providing for the installation of an ornamental lighting system covering 23 blocks in the downtown district has been passed by the City Council. The cost is estimated at $64,833.

SEATTLE, WASH.—The City Utilities Committee has approved an ordinance authorizing the enlargement of the Cedar Falls light and power plant. It is proposed to replace the two generating units having a combined capacity of 9,000 kw. with a new generating unit of 12,500 kw., also to enlarge the power house, and to rebuild No. 2 pipe line from the masonry dam to the power house, increasing the size from 68 in. to 78 in. An appropriation of $400,000 has been made for the work. Bids, it is understood, will soon be called for a dam at Diablo Canyon on the Skagit River, to cost about $3,400,000.

ASTORIA, ORE.—Plans for the proposed paper and pulp mill to be built by the Northwest Pulp & Paper Company, to cost about $1,500,000, include a power plant. B. T. McBain, Oregonian Building, Portland, Ore., is architect.

LOS ANGELES, CAL.—Bids will be received by the Board of County Supervisors, Court House, until Sept. 6, for the installation of an ornamental lighting system on Vernon Avenue and other streets in the Park View tract, using cast-iron standards.

Electrical Patents

Announced by U. S. Patent Office

(Issued July 26, 1927)

1,637,052. PROCESS OF PRODUCING METALLIC CARBON; C. Robinson, Baltimore, Md. App. filed Aug. 1, 1921.

1,637,054. CONTROLLER FOR ELECTRIC MOTORS; E. W. Seeger, Milwaukee, Wis. App. filed Sept. 5, 1925. Of the counter-electromotive-force type.

1,637,057. INDUCTION MOTOR EXCITING SYSTEM; W. Seiz, Baden, Switzerland. App. filed April 6, 1926.

1,637,059. ELECTRIC CONNECTOR; A. H. Simmons, Oak Park, Ill. App. filed March 25, 1924. For appliances.

1,637,063. ELECTRIC WELDING; E. Thomson, Swampscott, Mass. App. filed Oct. 25, 1924. Resistance line or seam welding.

1,637,090. AUTOMATIC DISCONNECTING POTHEAD; A. C. Rumble, Los Angeles, Cal. App. filed Nov. 5, 1926.

1,637,155. ELECTRIC STOVE; J. E. Marsden, Philadelphia, Pa. App. filed Jan. 14, 1926. Whereby the generation of heat is controlled automatically coincident with the act of placing a vessel or the like upon the stove or removing the same therefrom.

1,637,167. ELECTRICAL HEATING BODY FOR HIGH TEMPERATURES ESPECIALLY FOR CERAMIC METALLURGICAL PROCESSES AND CHEMICAL PROCESSES; F. Weckerle, Munich, Germany. App. filed Aug. 24, 1925.

1,637,182. ROTOR FOR ELECTRICAL MACHINES; A. Glaubitz, Mulheim-Ruhr, Germany. App. filed May 17, 1926. Damping winding for turbo-generator rotor.

1,637,199. CUT-OUT DEVICE FOR PNEUMATICALLY OPERATED SWITCHES; G. Meyfarth, Geneva, Switzerland. App. filed Nov. 4, 1924.

1,637,205. FLUID-HEATING FAUCET; K. Tramp, Chicago, Ill. App. filed June 2, 1926.

1,637,237, 1,637,238. TRANSFORMER FOR ELECTRIC ARC CUTTING AND WELDING APPARATUS; F. C. Owen, Fayetteville, N. C. Apps. filed April 15, and May 1, 1926.

1,637,262. ELECTRICAL APPARATUS; J. C. Marshall, San Francisco, Cal. App. filed Jan. 2, 1926. Connector for industrial use.

1,637,274. FUSE-PLUG CAP ASSEMBLY; N. W. Nutt, Trenton, N. J. App. filed Jan. 25, 1927.

1,637,275. DOORLOCK; V. Peterson, Chicago, Ill. App. filed Nov. 22, 1926.

1,637,292. METHOD OF STARTING INDUCTION MOTORS AND APPARATUS THEREFOR; H. O. Bree, Auckland, New Zealand. App. filed July 15, 1926. To provide an improved power factor over the whole starting period.

(Issued Aug. 2, 1927)

1,637,328. ELECTRODE FOR ELECTROLYTIC CONDENSERS; C. Aalborg, Pittsburgh, Pa. App. filed Oct. 23, 1920. Also for lightning arresters, rectifiers, etc.

1,637,329. INSULATOR; C. Aalborg, Pittsburgh, Pa. App. filed March 15, 1922. Link type.

1,637,351. CIRCUIT-INTERRUPTING DEVICE; K. C. Randall, Edgewood Park, Pa., and H. K. Ansingh, Murrysville, Pa. App. filed March 30, 1921. An electrical protective and circuit-interrupting device for use in tapping a relatively high-voltage line.

1,637,356. PROTECTIVE SYSTEM FOR MOTORS; W. H. Smith, Wilkinsburg, Pa. App. filed June 1, 1925. Control system for motor-generator sets of the type used for propelling vehicles.

1,637,360. CIRCUIT-INTERRUPTING SYSTEM; H. A. Travers, Forest Hills Borough, Pa. App. filed July 9, 1921. An arrangement for preventing an electrically operated circuit interrupter from being held closed when a short circuit or heavy overload obtains on the circuit controlled by the interrupter.

1,637,370. VOLT-AMPERE-HOUR METER; G. A. Cheetham, Manchester, England. App. filed Aug. 19, 1922.

1,637,374. INSULATOR; C. L. Fortescue, Pittsburgh, Pa. App. filed June 29, 1922. Suspension type.

1,637,390. ELECTRICAL MEASURING INSTRUMENT; R. T. Pierce, Wilkinsburg, Pa. App. filed Feb. 3, 1923.

1,637,391. ELECTRIC HEATING STRUCTURE; T. C. Russell, Chicago, Ill. App. filed July 23, 1926. For units to be used in electric flatirons, pots and percolators and other electrically heated utensils.

1,637,393. DOUBLE-RANGE, VARIABLE-SPEED INDUCTION-MOTOR SET; E. B. Shand, Pittsburgh, Pa. App. filed April 21, 1923.

1,637,396. ALARM SYSTEM; S. Solodar, New York, N. Y. App. filed Nov. 1, 1924. By which the assistance of police or firemen may be summoned in the event of need.

1,637,401. METHOD OF AND MEANS FOR CONTROLLING RECIPROCATING MOTORS; C. S. Weyandt, Pittsburgh, Pa. App. filed March 5, 1924.

1,637,433. DRY CELL; V. Yngve, South Orange, N. J. App. filed Jan. 12, 1925. Method of preparing the depolarizing mixture.

1,637,435. ELECTRIC OVEN; T. G. Brown, St. Laurent de Montreal, Quebec, Canada. App. filed Feb. 25, 1926. Method of mounting and connecting heating elements of electric ovens.

1,637,442. ALTERNATING-CURRENT SELECTOR; H. G. Dorsey, Gloucester, Mass. App. filed Oct. 12, 1917. Will respond only to a predetermined definite range of frequencies of alternating current.

1,637,446. DRY CELL; W. F. Hendry, Ossining, N. Y. App. filed July 30, 1923.

1,637,461. ELECTRICAL SWITCH; W. F. Wells, Chicago, Ill. App. filed March 8, 1926. Snap switch of the quick-acting make-and-break type.

1,637,463. COMBINATION ELECTRICAL CONNECTOR AND FIXTURE SUPPORT; R. B. Benjamin, Chicago, Ill. App. filed Dec. 6, 1920.

1,637,472. ELECTRICAL TESTING APPARATUS; J. M. Coote, Elizabeth, N. J. App. filed June 21, 1921. For quickly and conveniently determining the condition of various electrical apparatus, for example such as fuses either of the plug, ferrule or knife-blade type, as well as lamps, bells, coils, etc.

1,637,486. ELECTRIC FURNACE; J. Kelleher, Chippawa, Ontario, Canada. App. filed July 17, 1925. Of the type which employ carbonaceous resistors.

1,637,610. CURRENT-INTERRUPTING DEVICE; A. Herz, Chicago, Ill. App. filed March 3, 1924. Employing mercury for an open fuse.

1,637,659. THERMO-ELECTRIC OVEN; S. Sacerdote, Milan, Italy. App. filed April 7, 1926.

1,637,717. RECIPROCATING MOTOR SYSTEM; C. S. Weyandt, Pittsburgh, Pa. App. filed July 26, 1922. For driving tools.

1,637,740. ELECTRIC WINDOW-CLOSING DEVICE; F. Dzierzenga, Brooklyn, N. Y. App. filed Sept. 20, 1926.

1,637,786. INCANDESCENT-LAMP STRUCTURE; J. J. Rekar, Los Angeles, Cal. App. filed Feb. 15, 1926. Means for fastening a lamp to its base.

1,637,795. ELECTRODE FOR RECTIFIERS AND ELECTROLYTIC CONDENSERS; E. F. Andrews, Chicago, Ill. App. filed Sept. 10, 1926.

1,637,813. RECIPROCATING ELECTRIC MOTOR; H. E. Fox, Pittsburgh, Pa. App. filed Nov. 21, 1923. Motors employed as percussive tools.

1,637,822. THERMOCOUPLE; O. Hermann, Chicago, Ill. App. filed Sept. 9, 1926. The preparation of alloys or metallic mixtures for thermocouples.

1,637,828. ELECTRICAL APPARATUS; M. Latour, Paris, France. App. filed Aug. 19, 1921. (Granted under the provisions of the act of March 3, 1921.) In high-frequency apparatus relying upon the phenomenon of magnetic saturation for its operation and having a magnetic circuit and means for cyclically supersaturating it, a magnetic circuit comprising substantially all nickel and containing silicon adapted to increase the sharpness of the saturation bend.

1,637,837. CIRCUIT CLOSER; G. W. Shaw, Philadelphia, Pa. App. filed Feb 1, 1923. Means for controlling the circuit through an audible or visible electric alarm or signal.

1,637,852. RECORDING INSTRUMENT; W. C. Brandenburg, Weston, W. Va. App. filed Sept. 8, 1924. For recording the maximum demands in kw.-hr. of an alternating-current circuit in such a way that the maximum demand in kva.-hr. and the power factor occurring at this demand may be readily ascertained from the record.

1,637,863. FREQUENCY CHANGER; G. H. Jump, Buffalo, N. Y. App. filed March 18, 1925.

1,637,874. SOCKET CASING; A. C. Recker, Oakville, Conn. App. filed Dec. 14, 1925.

1,637,886. SINGLE-PHASE INDUCTION-MOTOR CONTROL SYSTEM; W. Weiler, Niederschonhausen, Berlin, Germany. App. filed Oct. 16, 1926.

Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

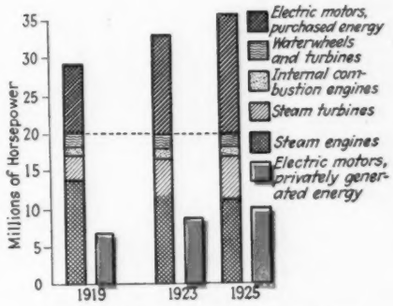
Manufacturing Establishments Three-fourths Electrified

THE recently published data on prime movers in industrial establishments, embodying results of the 1925 Census of Manufactures, clearly indicate the progressive electrification of industry in the United States, especially through the rapidly increasing use of motors driven by purchased energy.

According to these statistics, in the six-year period from 1919 to 1925 the total primary horsepower increased from 29,297,963 to 35,772,628, or 22 per cent. This category includes the various forms of steam, water and internal-combustion engines, together with electric motors driven by purchased energy. The actual growth, however, was almost entirely in the last-named group, the installation in 1919 being 9,260,449 hp., whereas in 1925 it was 15,868,828 hp. The increase amounts to 71.3 per cent.

Mechanical prime movers have meanwhile remained almost unchanged at 20,000,000 hp., the reported figures for 1919, 1923 and 1925 being respectively 20,037,514, 19,724,090 and 19,903,800. The variation in six years is but little over 1 per cent, an amount so small that it could almost be accounted for by differences in reporting the same units, since a great many steam engines do not have ratings indicated on nameplates, and the reported horsepower is therefore an estimate.

It seems, though, that there actually has been a real, if small, decrease in the use of steam, consisting of a decided reduction in horsepower of steam engines and a gain in turbines nearly, but not quite, sufficient to offset it. While the former fell from 13,834,016 hp. to 11,434,388 hp., the turbines increased from 3,197,599 hp. to 5,482,468 hp. For the intervening year, 1923, no accurate segregation can be made, turbines not having been separately reported.



Industry Increasingly Electrified

Meanwhile electrification was gaining in another way, the mechanical prime movers being increasingly applied to the driving of electric generators. The horsepower thus used is not reported directly, but can be quite closely estimated. In the 1925 census a count was for the first time made of electric generators. Their total rating was 6,887,045 kw. Applying the usual ratios between generator and engine ratings gives a resulting figure for the latter that comes surprisingly close to the 10,254,745 hp. of motors driven by energy generated in the establishments reporting. That is, the generator efficiency, motor efficiency and diversity factor just about balance out. Presumably the same thing would be true for 1919 and 1923 if data were available.

This leaves only about 9,600,000 hp. of mechanical prime movers used directly for driving machinery, and 26,170,000 hp., or 73.1 per cent, in electric motor drive. Estimating the direct mechanical drive for the two previous census years on the same basis leads to about 13,000,000 hp. and 10,900,000 hp., and therefore a decrease first to 84 and then to 74 per cent of the 1919 installation, while electric drive increased from 16,225,623 hp. in 1919 to 26,122,573 hp. in 1925, or 61 per cent.

The statistics also reveal the situation with reference to one form of prime mover that has caused central-station officials some concern, as a competitor. That is the internal combustion engine. The competition is apparently not serious. While electric drive has been gaining at the rate of almost 2,000,000 hp. a year, the installed horsepower in internal combustion engines decreased in each census interval; between 1923 and 1925 it changed from 1,223,297 hp. to 1,186,116 hp.

Even more noteworthy has been the decrease in number of plants reporting internal combustion engines; these fell off by more than 50 per cent between 1919 and 1925; in 1923 there were 15,696 of them; two years later only 14,362. Thus it appears that it is the establishments with the smaller installations that are shifting most rapidly from internal combustion to electric drive.

From the viewpoint of the central-station company another feature deserves consideration, and that is the large aggregate horsepower not supplied with central-station energy and therefore to be considered a potential load, namely, the 20,000,000 hp. previously mentioned.

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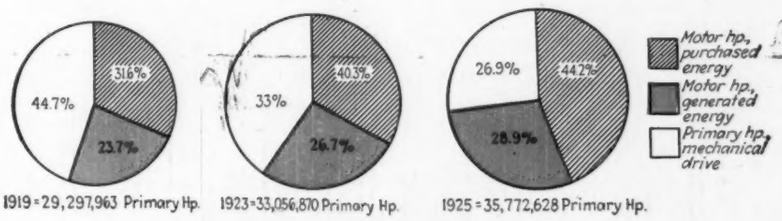


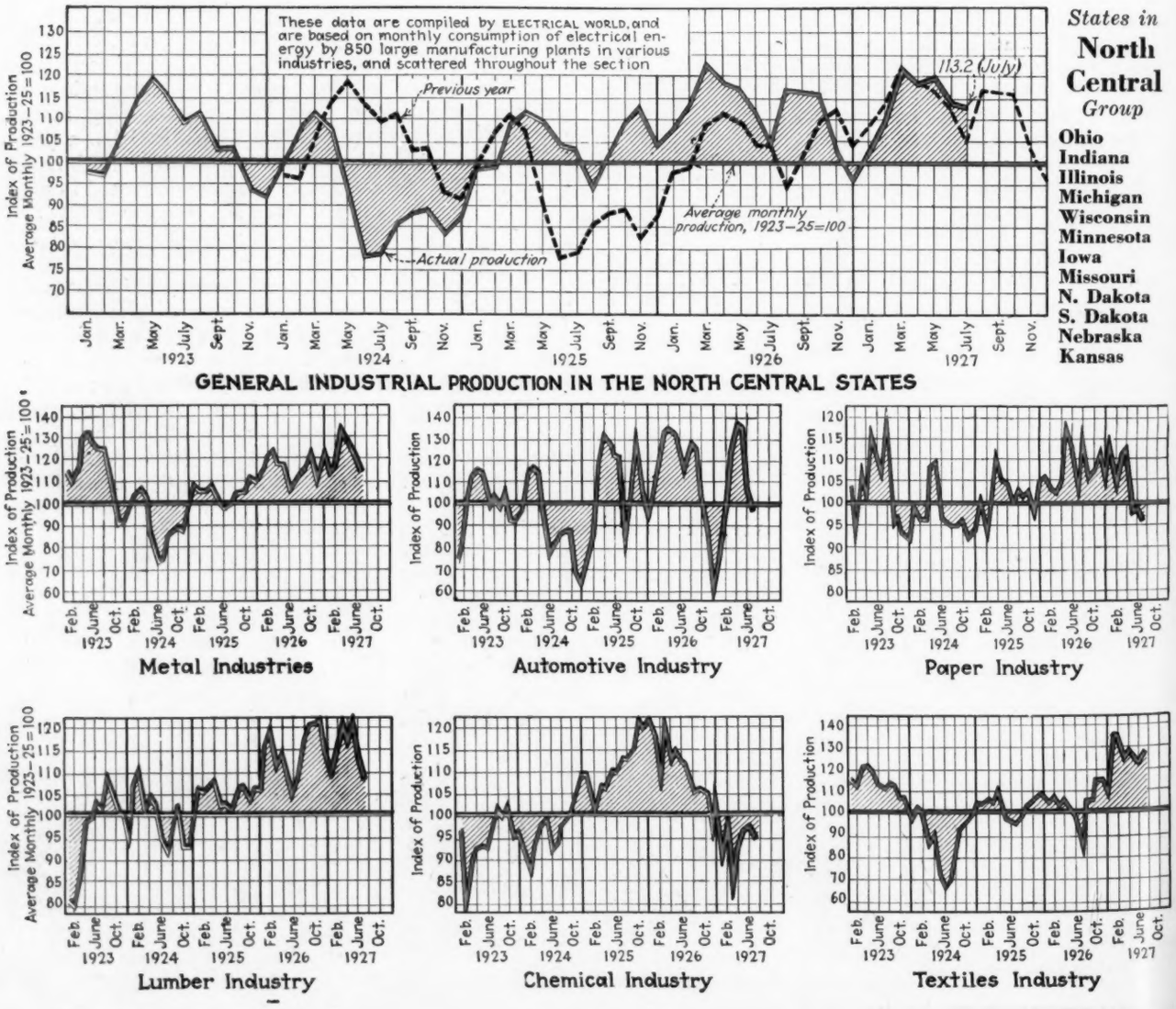
Central-Station Drive Shows Greatest Gains

Production in North Central States at High Level

INDUSTRIAL operations in the North Central States, as indicated by reports to the ELECTRICAL WORLD on the electrical energy consumption of more than 850 manufacturing plants, were of an unstable nature during July. Manufacturing plants in the same industrial group showed varying tendencies in production. Four of the industrial groups of the section—food, leather, the stone, clay and glass group, and textiles—reported productive activity materially greater than that reported during June, after correction is made for the number of working days in the two months. On the other hand, six industrial groups—rubber, paper and pulp, lumber, metal fabricating, rolling mills and steel plants, and the automobile group—all reported productive activities slightly under those of June. The resultant of this miscellaneous industrial activity was a productive activity of 3.2 per cent over June after corrections are made for the number of working days and proper weighting is given to the industries. The actual production, however, was 0.6 per cent under June, but was 8.8 per cent over July of last year. The basic reason for this increase in operations lies in the materially increased operations of the food industry, which normally during the summer months reaches its peak of production. This high rate of activity in the food preparation plants, flour mills, etc., in conjunction with a largely increased activity in the cement mills, leather-manufacturing plants and textile mills and shops, overcame the small decreases which were recorded by the other industrial groups of the section.

The industrial conditions witnessed in the North Central States during July bring out very sharply the large advantages to be gained from a diversity of industrial activity in any city or section, and also the advantages to the public utilities serving that section. If, for instance, the industrial activities in the North Central States were confined to the manufacture of automobiles, rubber products and iron and steel products, the July general industrial operations of that section would have been several per cent under those of June, not necessarily because of any unusual drop in the productive operations of these basic industries, but owing to a perfectly normal seasonal decline. But to meet this normal lower rate of operations in those industries the section has other basic industries, such as food and cement, the operations of which are normally high during the summer months. The manufacture of clothing is also of large importance in this section, this industry exhibiting a high rate of summer activity in preparation for the fall demand for heavier wearing apparel. Such a balance in industrial operations is not only conducive to a smoothing of the central-station yearly load curve, but it presents a partial solution of the summer non-employment situation as well. It is an excellent example of the self-sustaining qualities of American industry taken as a whole.

The metal industries, which include both ferrous and non-ferrous working plants, decreased their production activities by 1.3 per cent during July, but were still 1.5 per cent over the activities of the group recorded in July last year.

"Electrical World" Barometer of Industrial Activity in the North Central States

(Data Unadjusted for Seasonal Variation)